The Pequabuck River
State of the Watershed Report
December 2004

Prepared by: The Central Connecticut Regional Planning Agency in co-operation with the Pequabuck River Watershed Association & the Farmington River Watershed Association.

CCRPA

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State of Watershed Report Group

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Contributors

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Preface

Conservation and preservation of nature has become a global issue since the 1970s. Heavy industrialization during the first half of the 20th century highly affected the environment of the whole nation. In response to the negative impacts of industrialization, the United States enacted and implemented several environmental protection programs in the 1970s. The first US department created to address these issues was the Environmental Protection Agency (EPA), created in July of 1970. Following the tract of environmental protection and conservation, the Connecticut Department of Environmental Protection (CT DEP) was established in 1971. The mission of the CT DEP is "to conserve and improve natural resources and the environment in order to protect public health, safety, and welfare while preserving and enhancing the quality of life for present and future generations." One way they do this is by granting funds to regional or local agencies to complete studies such as this.

Environmental protection programs in the United States have successfully improved water quality during the last quarter century, yet many challenges remain such as controlling and regulating non-point sources. Many public and private organizations are joining forces to create multidisciplinary and multi-jurisdictional partnerships to focus on these problems, community-by-community and watershed-by-watershed. These collaborative approaches have the potential to result in significant restoration, maintenance and protection of water resources in the United States. Supporting these watershed approaches is a high priority for EPA's national water program (Watershed Approach Framework, 1996).

This report presents the state of one of Connecticut's important watershed regions, the Pequabuck River Watershed. The Pequabuck River Watershed is a tributary to the Farmington Regional Basin which drains to the Connecticut Major Basin. This report will lay out the watershed history and dynamics, current situation of water quality and quantity, fish and habitat, and land use in the watershed. This report is based on the critical data needed to provide a platform for the development of a comprehensive watershed management plan. This study is funded in part by the CT DEP through a US EPA Clean Water Act §604(b) grant.

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Executive Summary

The Pequabuck River Watershed Coalition is very pleased to present the State of the Watershed Report to highlight the history as well as the present watershed situation and provide a base guideline in preparing the management plan for watershed.

The Pequabuck River Watershed, a 57.9 square mile area which lies in the Central Valley of Connecticut and upland area, is a tributary to the Farmington Regional Basin that drains to the Connecticut Major Basin. The Pequabuck River Watershed is rich with various natural habitats supportive of fish and wildlife. The variety of habitats include lakes, shallow water, deep water, wetlands, marshes and wooded areas, shores of hardwoods, mixed conifers and shrubs.

The Pequabuck River Watershed experienced rapid human settlement during the early colonist period. Between 1860 and 1945, this area experienced an increase in industrialization and a decrease in agriculture. The Pequabuck River became one of the most polluted rivers in Connecticut since the early 1900's. The main reason for water quality degradation was the discharge of large quantities of poorly treated municipal sewage and industrial waste. Moves to improve water quality in the Pequabuck River were made in the late 1970's, as treatment procedures improved for both industrial discharge and wastewater treatment at municipal facilities. Three Water Pollution Control Facilities (WPCF) for the Towns of Plymouth and Plainville, and the City of Bristol are currently discharging their effluent into the Pequabuck River .

The mean daily streamflow averages about 81 cubic feet per second (cfs) with precipitation being the dominant contributor to the River flow. The surface waters of the Pequabuck River Watershed, including Poland River and Coppermine Brook, are classified from Class AA to C, with the majority of the river falling in Class B or C water. Although there has been a drastic reduction in bacteria such as E-coli and nutrients such as phosphorous and nitrogen concentration in the Pequabuck River since the late 1980s, much work is still needed to be done ahead to preserve and maintain the water quality as well as river and its surrounding environment. E-coli levels in the Pequabuck River still exceed the permissible limit for non-contact recreation. Nitrogen, along with phosphorous, which is identified as the nutrient responsible for the growth of algae and

eutrophication of fresh waterbodies, is present in the Pequabuck River in a significant amount.

The Watershed includes a total of 9339 acres of level B aquifer protection area. Almost half of the aquifer area in the region is already covered by residential, commercial or impervious surfaces. Three major water utilities (Bristol Water Dept., New Britain Water Dept., and Connecticut Water Company) are currently withdrawing surface water as well as groundwater from the watershed area. The Pequabuck River serves as a water source for various industrial and recreational purposes.

The Pequabuck River Watershed is an important natural habitat for different species of birds, plants and animals. More than 70% of the total watershed land is still covered by forest and open space. The Watershed provides habitat to at least three species of special concern mammals, eight different species of birds that are either listed as state endangered, threatened, or species of special concern, and at least three species of special concern reptiles. Different species of waterfowl can also be found in the watershed.

Land development is on rise in the Watershed. Residential and commercial development covers around 20% of the land. Approximately 17% of the watershed has more than 25% of impervious surface and about 31% of the watershed has between 10-25% of impervious surface. The trend of impervious surface is on the rise as more land development is being done for residential or other purposes. Impervious surface greater than 10% is considered to be adversely affecting water quality. Because of land development, the number of species of animals, reptiles, and birds is declining as the land development causes habitat destruction and other environmental problems.

This report will be used as a background report to develop a management plan for the Pequabuck River Watershed. The management plan will include strategies on determining the causes of impairment and other watershed related problems as well as strategies to improve the problems identified in this report.

Introduction

The Pequabuck River State of the Watershed Report is a collaborative effort of various groups concerned with the health of the Pequabuck River Watershed, to describe and disseminate the most updated water quality and flow information along with several other watershed related issues such as land use and habitat.

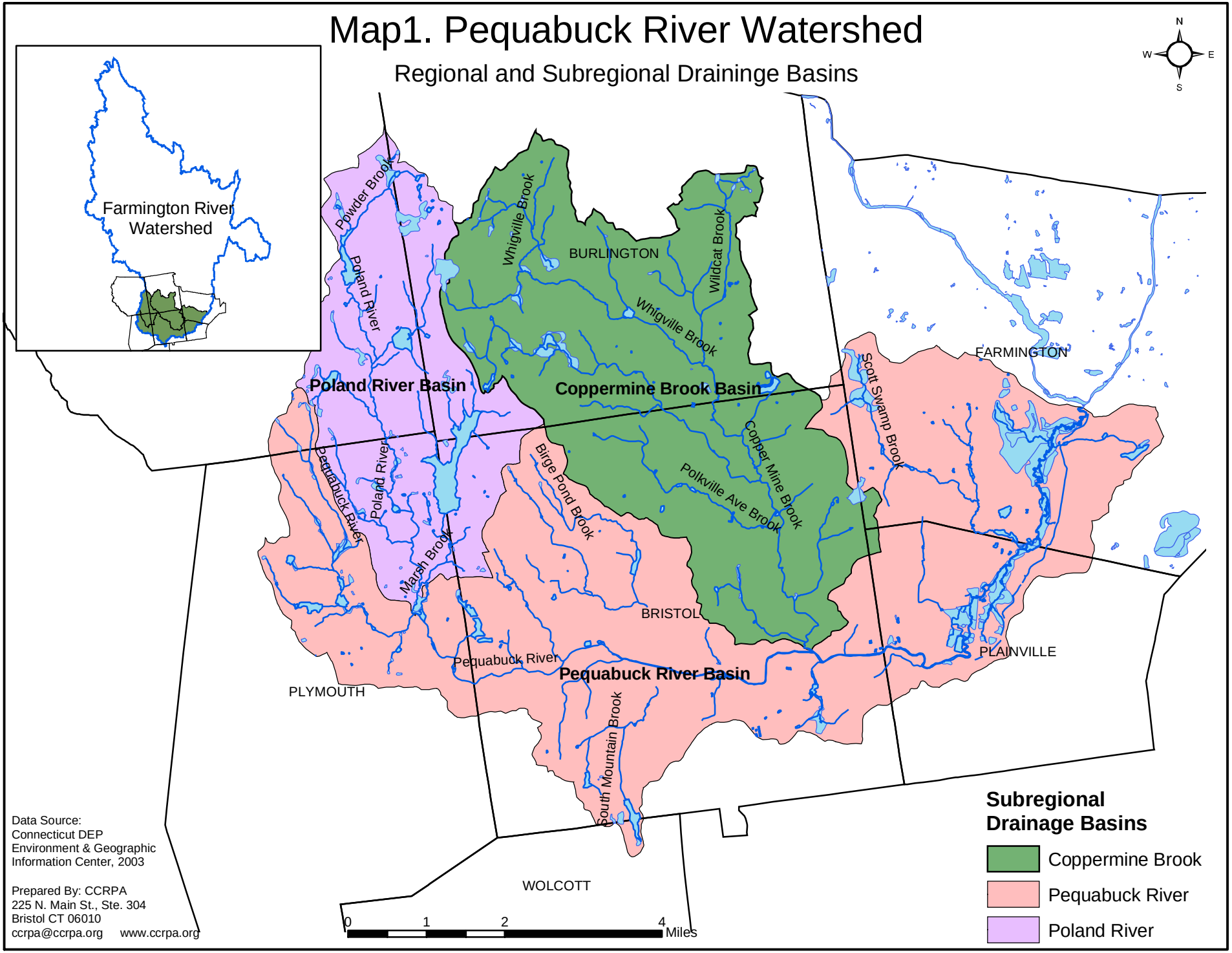
Located within the towns of Bristol, Burlington, Farmington, Harwinton, Plainville, Plymouth, and Wolcott, the Pequabuck River watershed's drainage area is 57.9 square miles. The Pequabuck River Watershed contains three different drainage basins within it: Pequabuck River subregional basin with a catchment area of 29.1 square miles, Poland River subregional basin with a catchment area of 10.2 square miles and Coppermine Brook subregional basin with a catchment area of 18.6 square miles. The Pequabuck River Watershed has a general west-east orientation with a total length of approximately 16 miles, excluding major tributaries. Map1 shows the watershed area along with its subregional drainage basins, and waterbodies that drain into the Pequabuck River watershed. The Pequabuck River and its tributaries are relatively shallow and most of the land in the drainage basin is rolling hills. The mean daily streamflow in the river measured at Forestville Gauging Station averages a fairly low 81cubic feet per second (cfs). Because the Pequabuck River passes through highly developed areas, rapid and high amount of runoff may cause bank erosion.

The Pequabuck River Watershed has several characteristics that make it important in the region. It provides shelter for many endangered species of birds such as the Cooper's Hawk, the Bald Eagle, the Great Egret, the Common Nighthawk and features many historical and natural elements such as the Eli Terry Jr. Waterwheel, Horseshoe

Falls, historic Downs Street Cemetery, and the Shade Swamp Sanctuary. The river is also an integral part of Rockwell Park and Brackett Park, and Memorial Boulevard in the City of Bristol. Appendix D lists a summary of findings from the previous study, “The Pequabuck River Watershed Action Plan”, which lists important areas in the watershed. The tributaries to the Pequabuck River, Coppermine Brook and Poland River, have provided water for both drinking and industrial purposes (Table 9 lists the major reservoirs, dams, and impoundments in the region).

Map1. Pequabuck River Watershed

Regional and Subregional Drainingе Basins



Demographics

The current population of the six towns (Bristol, Burlington, Farmington, Harwinton, Plainville, and Plymouth) in the watershed is about 126,478 (CERC 2002). The population and land area of the Town of Wolcott section of the watershed are minimal and deemed inconsequential for this report and are therefore excluded in the data collection and analysis process. The City of Bristol covers almost 40% of the watershed, with Burlington ranking second with 22% of the total watershed area. Table 1 below shows the area of each town within the watershed.

Table 1. Land area of towns within the Pequabuck River Watershed

Town	Total Town Acreage	Acreage in Watershed			Total	Percent of Town in Watershed	Percent of Total Watershed in Town
		Pequabuck	Coppermine	Poland			
Bristol	16,960	8,573.59	5,122.35	770.33	14,466.27	85.30%	39.13%
Burlington	19,072	18.44	6,697.65	1,439.1	8,155.19	42.76%	22.06%
Farmington	17,952	4578.97	62.93	*	4,641.9	25.86%	12.55%
Harwinton	19,680	230.47	*	2,696.17	2,926.64	14.87%	7.92%
Plainville	6,208	2,328.93	32.92	*	2,361.85	38.05%	6.39%
Plymouth	13,888	2,775.75	*	1,576.63	4,352.38	31.34%	11.77%
Wolcott	13,075	69.28	*	*	69.28	0.53%	0.19%
Total	106,835	18,575.43	11,915.85	6,482.23	36,973.51	35%	100%

*-- None of the town area falls under the watershed.
Data Source: Connecticut DEP, Environment & Geographic Information Center, 2003.

The demographics in the six towns show a population increase of approximately 20% between 1970 and 2000, with total population projected to reach 140,670 by 2020 (the US Census 2000; CT DOT). The highest population increases have been in the town of Burlington, from 4,070 in 1970 to 8,190 in 2000, and in the town of Farmington, from

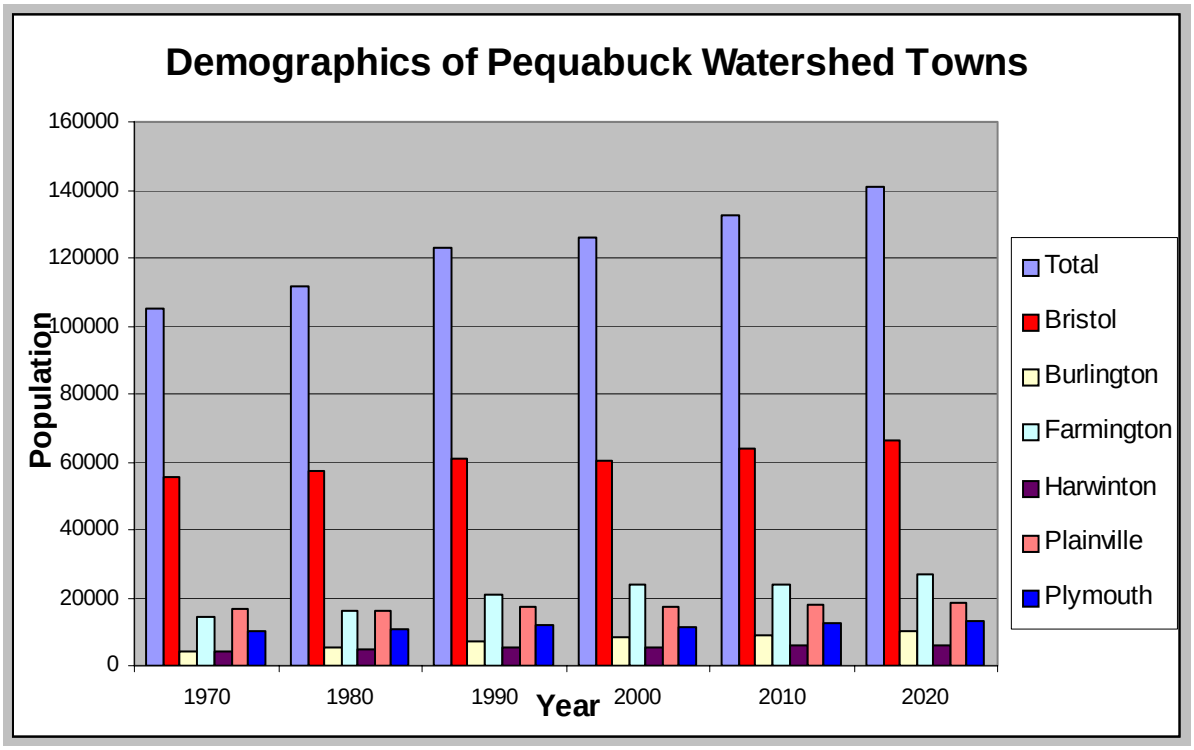
14,390 to 23,641. The following table (Table 2) and the chart (Chart 1) provide a general overview of population trends in the watershed towns.

Table 2. Demographics of the towns in the Pequabuck River Watershed*

Towns	1970	1980	1990	2000	2010*	2020*
Bristol	55,487	57,370	60,640	60,062	63,630	66,040
Burlington	4,070	5,660	7,026	8,190	8,810	10,130
Farmington	14,390	16,407	20,608	23,641	23,980	26,870
Harwinton	4,318	4,859	5,228	5,283	5,860	6,200
Plainville	16,733	16,401	17,392	17,328	17,880	18,470
Plymouth	10,321	10,732	11,822	11,634	12,410	12,960
Total	105,319	111,429	122,716	126,138	132,570	140,670

*--Projected population; Population data obtained from US Census 2000, CT DOT Population projections (2001), and Connecticut Economic Resource Center (CERC).

Chart 1. Demographics of Pequabuck River Watershed Towns*



*--Projected population; Population data obtained from US Census 2000, CT DOT Population projections (2001), and Connecticut Economic Resource Center (CERC).

Watershed History and Dynamics

Geology

The Pequabuck River Watershed lies between the New England Upland and the Connecticut Valley Lowland sections of the New England physiographic province[1] (La Sala, 1964). The western parts of Bristol and further west lie in the New England Upland section, an area of rugged topography and metamorphic rocks of Paleozoic age. The area is characterized by hilly, irregular topography. In the Upland, most summits are about 900 feet in altitude with few below 600 feet. The valley bottom drops from an altitude of about 510 feet at the western border of Bristol to about 250 feet at a point south of Hurley Hill, where the valley leaves the upland. The irregular hill masses in the Upland are cut by numerous small narrow valleys. In Plymouth, Bristol, and Burlington, these small valleys are tributaries to the Pequabuck River valley.

The eastern part of the watershed is in the Connecticut Valley Lowland. The Connecticut Valley Lowland extends northward through central Connecticut and into Massachusetts. This area is formed by the Triassic age lava flow and contains sedimentary rocks.

The metamorphic rocks comprise the Hartland Formation, Bristol Granite Gneiss, and Prospect Gneiss. These formations contain water in fractures. The rocks of Triassic age, in the area, are the New Haven Arkose, Talcott Basalt, Shuttle Meadow Formation, Holyoke Basalt, and East Berlin Formation.

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[1] The United States is dominated by a range of old mountains and plateaus, the Appalachians that runs north and south on the east side of the North American continent and young ranges of lofty mountains the Rockies, Cascades, and Sierra Nevada that run north and south in the western quarter of the continent. The great interior lowland extends from the Canadian Shield to the Gulf of Mexico. These dominant mountain and lowland areas have helped to define what are called the physiographic provinces of the United States.

Historical Land Use

The Central Valley of Connecticut was the main attraction area for early colonists. Being flat and fertile, the Central Valley became the first permanent European settlements in Connecticut, and by 1675, most of the Central Valley was converted to farmland. The Central Valley has several development advantages, other than farming, over the Uplands. Because the region is flat, transportation became easy in the area. Most of the major highways and railroads run in Central Valley or along the Coastal area. As the Central Valley started getting crowded, the colonists slowly captured the Uplands. The colonial Upland farms were moderately small, usually around 40 to 50 acres, but a large variety of crops were grown (Bell 1985).

The Pequabuck River Watershed was a very important area for the early colonist as it provided a valuable supply of drinking water to maintain an urban population, for dilution of industrial and urban wastes, and for various industrial processes requiring large volumes of water. Although almost half of the watershed areas fall in the Upland area, the flat and fertile Central Valley provided various opportunities for dense settlements, and industrial development. Between 1860 and 1945, Connecticut experienced an increase in industrialization and a decrease in agriculture (Bell 1985). The Pequabuck River Watershed also followed the same trend of industrialization. Throughout the early and middle 1800's, Bristol was the premiere clock manufacturing center of the world. From the clockmaking, springmaking and ballbearing industries in the early 1800's to the automotive, high-tech sportscasting and recycling businesses of the 20th and 21st centuries, the watershed has provided incentives for dense development

in the area. The City of Bristol, which is the densest town in the watershed, currently has a population of over 60,000 (CERC 2002).

Industrial development and dense population that started in the watershed area in the early 1800's adversely impacted the watershed and rivers. Rivers were used more as waste disposal and water sources for industrial uses rather than as a part of the environment that should be preserved. The Pequabuck River and its tributaries, too, were not unaffected by industrial development. The Pequabuck River became one of the most polluted rivers in Connecticut since the early 1900's. The main reason for water quality degradation was the discharge of large quantities of poorly treated municipal sewage and industrial wastes. Similarly, dense residential and industrial development in the watershed towns and a large concentration of impervious surfaces further exacerbated the runoff of pollutants into the river. In the 1950's, the Pequabuck River became so polluted that it looked like an open sewer line with black sewage and other waste flowing in it. At times, the water in the river was every color of the rainbow; it was murky; devoid of fish; and offensive odors were common. The worst water quality situation coupled with the great flood of 1955 and urbanization of the early 1960s led to the channelization of the Pequabuck River in the downtown Bristol area.

In the late 1970's, efforts were made to improve water quality in the Pequabuck River, as treatment procedures improved for both industrial discharges and wastewater treatment at municipal facilities. As the three sewage treatment plants in the watershed upgraded their processing, dramatic reductions of certain pollutants were achieved. Todate, many water quality regulations and initiatives have been implemented since the 1970's to improve water quality in the river and its tributaries.

Hydrography

Although water covers a majority of the earth's surface, only three percent of it is fresh water. Even of that three percent of fresh water, a majority is trapped in polar regions in the form of icecaps and glaciers. Fresh and good quality water, therefore, is a limited and precious resource which should be utilized wisely.

Figure 1. The Hydrologic Cycle

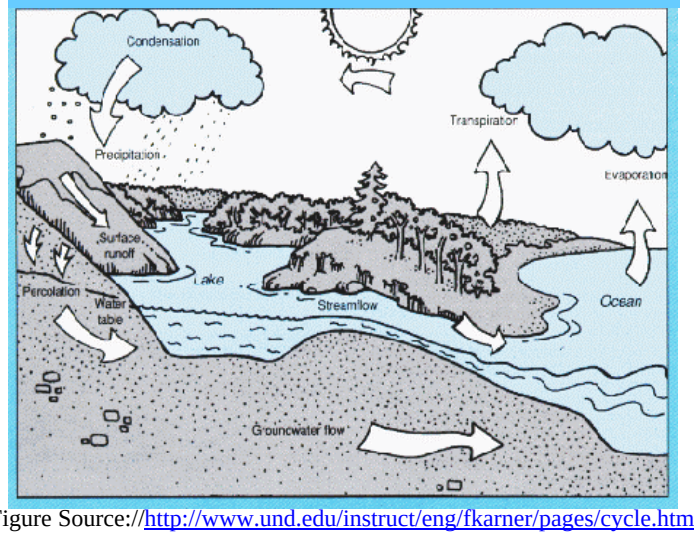


Figure Source://http://www.und.edu/instruct/eng/fkarner/pages/cycle.htm

Water's continuous movement from one form to another and from one part of the ecosystem to another, i.e., the oceans, the atmosphere, and the earth in the form of evaporation, precipitation, and runoff, is called the hydrologic cycle. When precipitation or rainfall occurs on the surface of the earth, it either seeps into the ground or flows on the surface of the earth as runoff. The amount of runoff depends on topography, and vegetation on the earth's surface. According to the National Climatic Data Center, the state of Connecticut received 47.15 inches of average annual rainfall between 1940 and 2002. The rainfall data also shows a 0.96 inches per decade increase in precipitation (Chart 7).

Surface water, which infiltrates the ground, moves with gravitational force. This water flows downward until it reaches the saturation zone. The saturation zone is the area of earth where all the spaces between sediment particles are filled with water. When the

infiltrated water reaches the saturated zone, it starts lateral movement towards areas where recharge is required.

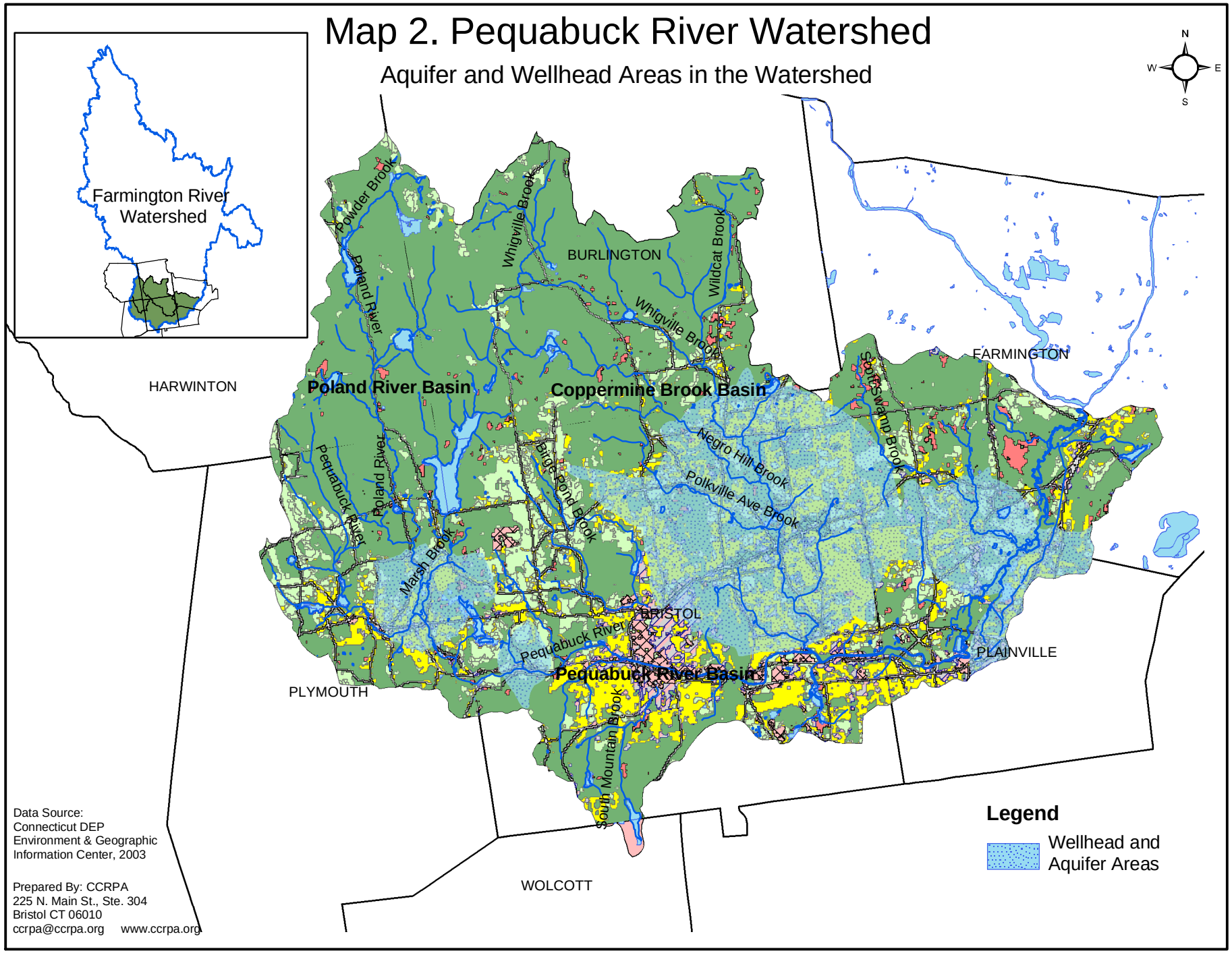
Groundwater is an important recharge source to surface waterbodies. Similarly, if the water table drops below the level of the surface water, surface waterbodies recharge the groundwater to maintain its level. According to the USGS data at groundwater monitoring well (BU 2) in Burlington, in 1965 when 30.98 inches of annual rainfall was recorded, the depth of groundwater level reached 34 feet below the ground surface comparing to just over 15 feet below ground surface in 1967, when 45.1 inches of annual rainfall was recorded. Stream flow in the watershed also fluctuated accordingly (Chart 8). In conclusion, there is a constant interaction between groundwater, and surface water.

Water Yield and Aquifer

The Pequabuck River Watershed and its aquifers have provided good quality and ample quantity of water to residents of towns in the region. Water companies and towns get their drinking water from the aquifer and other waterbodies located in the watershed. Aquifers are the layers of underground soil, sand and rocks, which store and enable the movement of groundwater through its layers. The following Map (Map 2) and table (Table 3) shows proposed Level B aquifer protection area in the watershed region. As shown in the map, there is a total area of 9,339 acres of level B aquifer (See page 81 for details) protection area in the watershed. The majority of the area is located in the City of Bristol and the rest is distributed in other towns.

Map 2. Pequabuck River Watershed

Aquifer and Wellhead Areas in the Watershed



Data Source:
Connecticut DEP
Environment & Geographic Information Center, 2003

Prepared By: CCRPA
225 N. Main St., Ste. 304
Bristol CT 06010
ccrpa@ccrpa.org www.ccrpa.org

Table 3. Aquifer Protection Area in the Pequabuck River Watershed				
Town Names	**Aquifer Area in Acres**	**Town Area in Acres**	**Area of Aquifer in the Watershed**	**% of Town Aquifer Area in the Watershed**
Burlington	591.65	19,495.7	141.7	0.73
Bristol	5,823.4	17,167.7	5,823.4	33.92
Farmington	4,068.7	18,382.3	1,167.39	6.35
Plainville	3,678.3	6,310.7	1,241.78	19.68
Plymouth	965.11	14,284.7	965.11	6.76

The aquifer generally gets its recharge from the precipitation and subsequent infiltration. When water is pumped from an aquifer exceeding more than recharge, water levels decline in the aquifer. Eventually it may cause deleterious effects on streams, marshes, and springs. This groundwater- surface water interaction can be highly affected by human actions on the surface and sub-surface of the earth.

Map 2 clearly depicts that almost half of the aquifer area in the region is already covered by residential, commercial or impervious surfaces. The aquifer areas in the Town of Plymouth and the City of Bristol are heavily covered by either residential or industrial/manufacturing uses of land. One reason for this development is the accessibility of groundwater. If public water supply is not an option, development generally occurs where potable groundwater is readily available. A dense residential/industrial development with considerable amount of impervious surface may adversely impact the functioning of the aquifer and its interaction with surface waterbodies. Similarly, the higher the amount of impervious surface, the lower the chances are of infiltration and, thus, the lower the chances are of groundwater recharge. However, where industrial or commercial development occurs over drinking water aquifers, it may not be prudent to promote infiltration as contaminated run-off may

adversely affect the aquifer. In this context, high-density development in the immediate aquifer area is not healthy for both quality and quantity of groundwater. Although the watershed towns have not experienced any major aquifer problems, it is important to enforce proper regulations to protect aquifer areas from future degradation.

Change in land use and vegetation highly affects the quality of an aquifer. An increase in impervious surfaces such as rooftops, roads, and other pavements prevents water from entering into the ground and lowers the rate and quantity of recharge. Additionally, impervious surfaces also tend to create polluted runoff by collecting various organic and inorganic substances from its surface and discharging it into the nearby waterbody. As infiltration rates are decreased, surface runoff volume and rate both increase which can lead to flash flooding and bank erosion of streams and watercourses.

In the context of aquifer and its protection, towns in the watershed have adopted aquifer protection policies in their Plans of Conservation & Development and other land use regulations, to address any potential problems that may occur in the region/towns. The Plymouth town Plan of Conservation & Development is in the process of being updated. The old plan documents the needs for careful assessment of new development plans that may impact the aquifer and recommends scrutiny to ensure protection of the aquifer. The Town of Burlington, in its Plan of Conservation & Development, puts emphasis on protection of surface water and groundwater quality by drafting appropriate regulations. Similarly, the Town of Plainville's Plan of Conservation & Development recommends identifying aquifer protection zones, and adopting proper aquifer protection regulations.

Water Quality

One of the major concerns in the Pequabuck River Watershed has been its water quality. The Pequabuck River had been one of the most polluted rivers in Connecticut since the early 1900s. The main reason for water quality degradation was the discharge of large quantities of poorly treated municipal sewage and industrial/manufacturing waste such as General Motors automobile plant. While the water quality in the Pequabuck River has improved significantly since the late 1980s, the Connecticut Department of Environmental Protection (CT DEP) has listed (Section 303(d) reporting) many segments within the Pequabuck River Watershed as impaired waterbodies due to high turbidity, high levels of bacteria, habitat alteration, and unknown stressors in the water.

There are several reasons associated with the impaired water quality of the river. Historically, industrial and manufacturing wastes as well as poorly treated sewage were the main culprits of the river pollution. This dynamic has changed and lately impervious surfaces, and non-point sources carrying pollutants are the major contributing factors to the river pollution. The sewage treatment plants are still responsible for the higher amount of nutrient concentrations such as phosphorous and nitrogen but they are not the major sources of bacteria. There exists a large concentration of impervious surfaces as a result of dense development in the watershed towns. These impervious surfaces facilitate the runoff of pollutants into the river. Similarly, various non-point sources such as storm sewage, and chemicals used by households and for other purposes further contribute to the pollution of river water.

The CT DEP has adopted water quality standards consistent with the federal Clean Water Act. “These standards set a goal of restoring and maintaining the chemical,

physical, and biological integrity of Connecticut surface waters, and whenever attainable, providing for the protection and propagation of fish, shellfish, and wildlife and provide for recreation in and on the water" (CT DEP Water Quality Standards, 2002, p.iii). Based on the Water Quality Standards, Water Quality Classifications establish designated uses for surface and ground waters and identify the criteria necessary to support these uses. The Water Quality Classification classifies inland surface waters into four different categories ranging from Class AA to D. The following table (Table 4) provides a synopsis of the Water Quality Classifications. Appendix C provides detailed classification criteria and designated uses for each class.

Table 4. Connecticut Surface Water Quality Classification*

Designated Use	Class AA	Class A	Class B	Class C	Class D
Existing/proposed drinking water supply	x				
Potential drinking water supply	x	x			
Fish and wildlife habitat	x	x	x		
Recreational use	x	x	x		
Agricultural and industrial use	x	x	x		

*--Data obtained from CT DEP Water Quality Standards, 2002.

The surface waters of the Pequabuck River Watershed, including Poland River and Coppermine Brook, are classified from Class AA to C/B, with the majority of the river falling in Class B or C/B designation. Coppermine Brook and Poland River are classified as A or higher until they meet the Pequabuck River. The Pequabuck River is classified as A until it reaches Terryville in Plymouth where it becomes B and C/B in some sections. The goal for the Pequabuck River is achievement of Class B criteria and attainment of Class B designated uses as defined by CT DEP. Class B designated uses

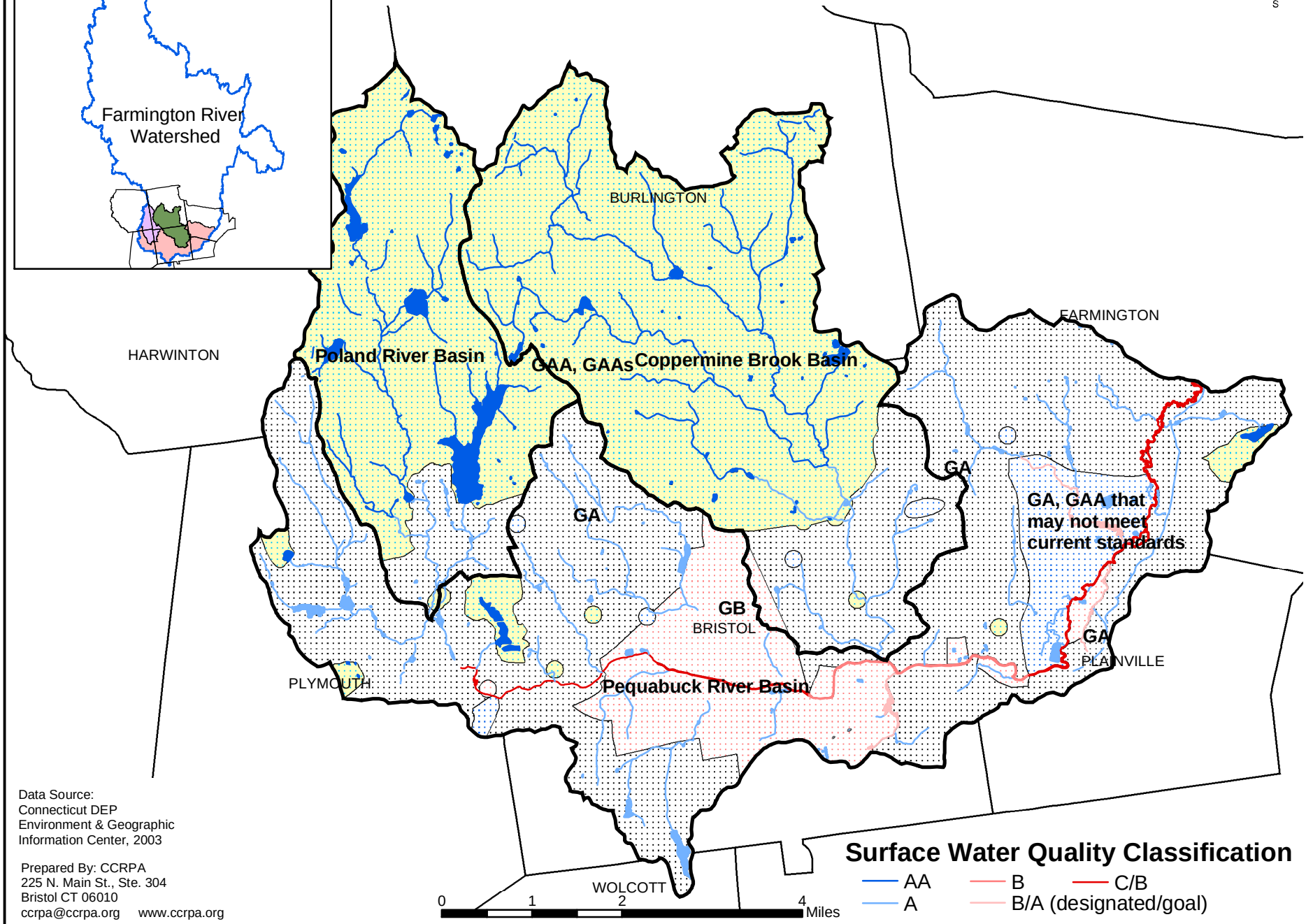
are: habitat for fish and other aquatic life and wildlife; recreation; navigation; and industrial and agricultural water supply. Map 3 shows the surface water quality situation in the region (CT DEP, Water Management Bureau).

The water quality in the Poland River, a tributary to the Pequabuck River, is relatively good, as water flows through undeveloped forested areas and is exposed to fewer human activities and external pollutants. The Pequabuck River, downstream from the confluence point with the Poland River, begins to experience water quality degradation as stormwater runoff from impervious surfaces, and storm drains are discharged into the river. Old and failing septic systems and common household practices also add pollutants to the river, such as the use of fertilizers, pesticides and toxic cleansers. Traveling further east, the Pequabuck River receives inflow from Coppermine Brook, which originates in the town of Burlington and flows from the north through the Nassahegan State Forest and into Forestville. The water quality in the Coppermine Brook is fairly good from its headwaters to the southern boundary of the New Britain Water Department Watershed. However, the section from the drinking water watershed boundary to the mouth at the Pequabuck River is not supporting the overall designated use as a result of pathogens and bacteria in the water and some other unknown sources. Finally, the Pequabuck River discharges into the Farmington River near Shade Swamp Sanctuary in the Town of Farmington.

The hydraulic characteristics of the Pequabuck River change significantly over its length. From the Town of Plymouth to the City of Bristol, it is a rapid, shallow and turbulent stream. The Plainville section of the river is relatively low grade, slow, and relatively deep. In the Shade Swamp area, the river channel is about 3 to 4 feet deep with few isolated riffle areas.

Map 3. Pequabuck River Watershed

Groundwater and Surface Water Quality Classification



Data Source:
Connecticut DEP
Environment & Geographic
Information Center, 2003

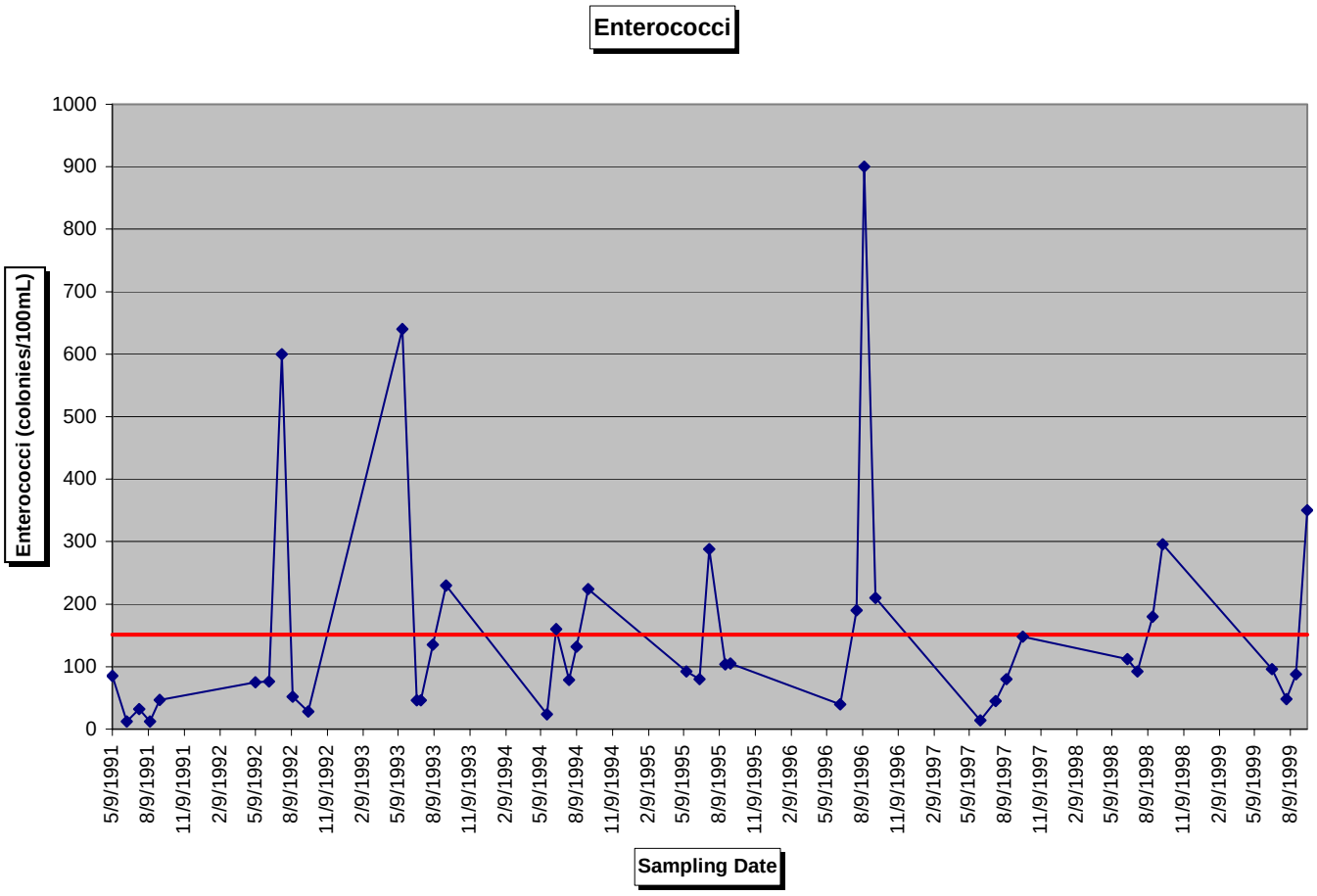
Prepared By: CCRPA
225 N. Main St., Ste. 304
Bristol CT 06010
ccrpa@ccrpa.org www.ccrpa.org

In the summer of 2002, the Connecticut River Watch Program (CRWP) in collaboration with the Pequabuck River Watershed Association (PRWA), conducted a water quality sampling program. Samples of water collected from various points along the Pequabuck River and its tributary, Coppermine Brook, were tested to determine present water quality. For a synopsis of the test results please refer to Appendix A. From the tests results, it was found that pH was in good balance and within the accepted standards. E-coli levels in 12 out of 41 samples exceeded the permissible single sample criteria of 576 colonies/100mL (non-contact recreation). Because the amount of E-coli fluctuate from time to time and from one point to another, it is difficult to locate the exact source of bacteria. The bacterial presence, which seems to fluctuate with storm events, may suggest the entry of bacteria from external sources. Similarly, it also depends on the disinfection of effluent in wastewater facilities in watershed towns. The presence of bacteria is likely attributed to discharges such as undisinfected effluent from wastewater treatment plants, failing septic systems, animal waste transported through runoff and waterfowl. In any case, the observed levels of E-coli in water make the water unsuitable for contact recreational uses and a greater risk to public health.

The United States Geological Survey (USGS) also records bacterial measurements for the Pequabuck River in Farmington. According to USGS, 30% of the samples collected between 1990 and 2000 (between the months of May 1 and Oct 1) exceeded enterococci criteria of 151 colonies/100mL used to assess waters for use support of contact recreation during that period of time (CT DEP 2002 Water Quality Report to Congress). Chart 2 below shows the enterococci concentration in the Pequabuck River water measured at the USGS Gauging Station, Farmington, Connecticut. Enterococci is one of the indicator bacteria that the CT DEP currently uses

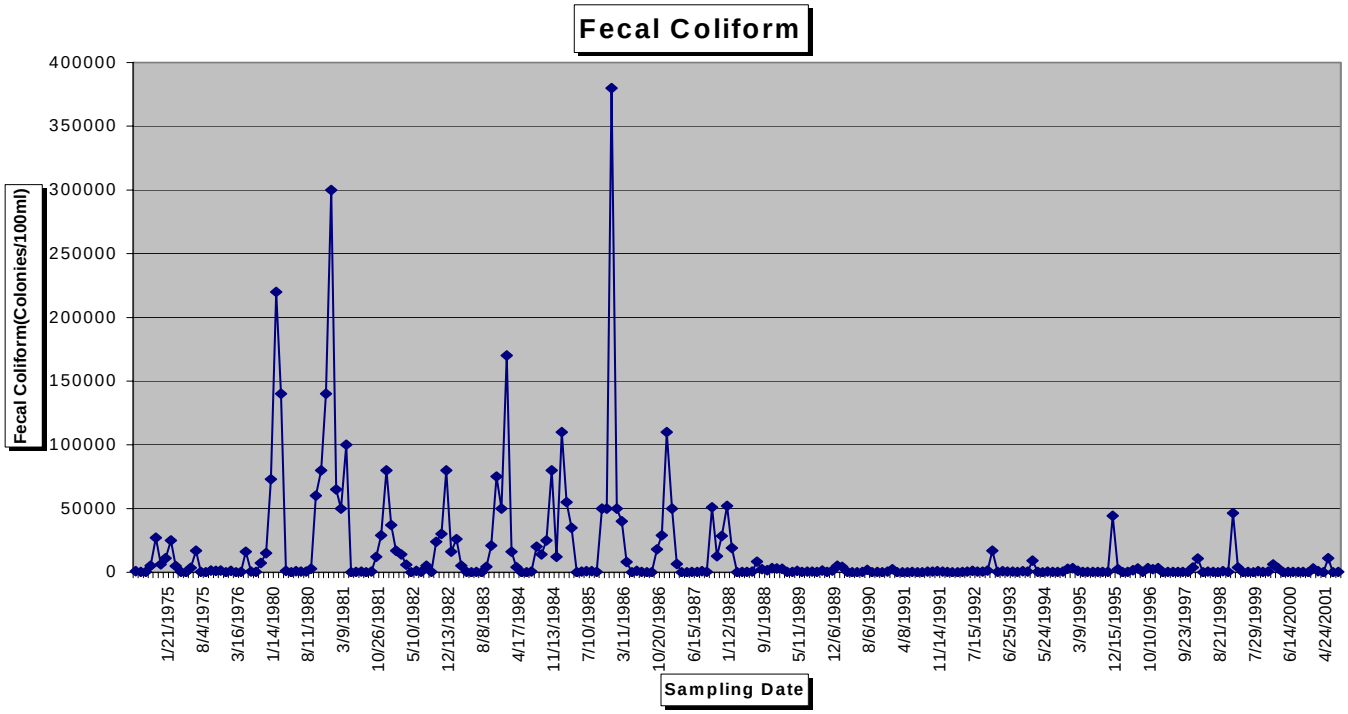
to determine water quality. The State of Connecticut Water Quality Standards require all sewage treatment plants located north of Interstate Highway 95 (I-95) to disinfect their wastewater from May 1 to October 1 (CT DEP Water Quality Standards, 2002). This seasonal disinfection is mainly intended to protect the sanitary quality of waters for recreational uses and also to protect human health from any potential bacterial contamination.

Chart 2. Enterococci Concentration



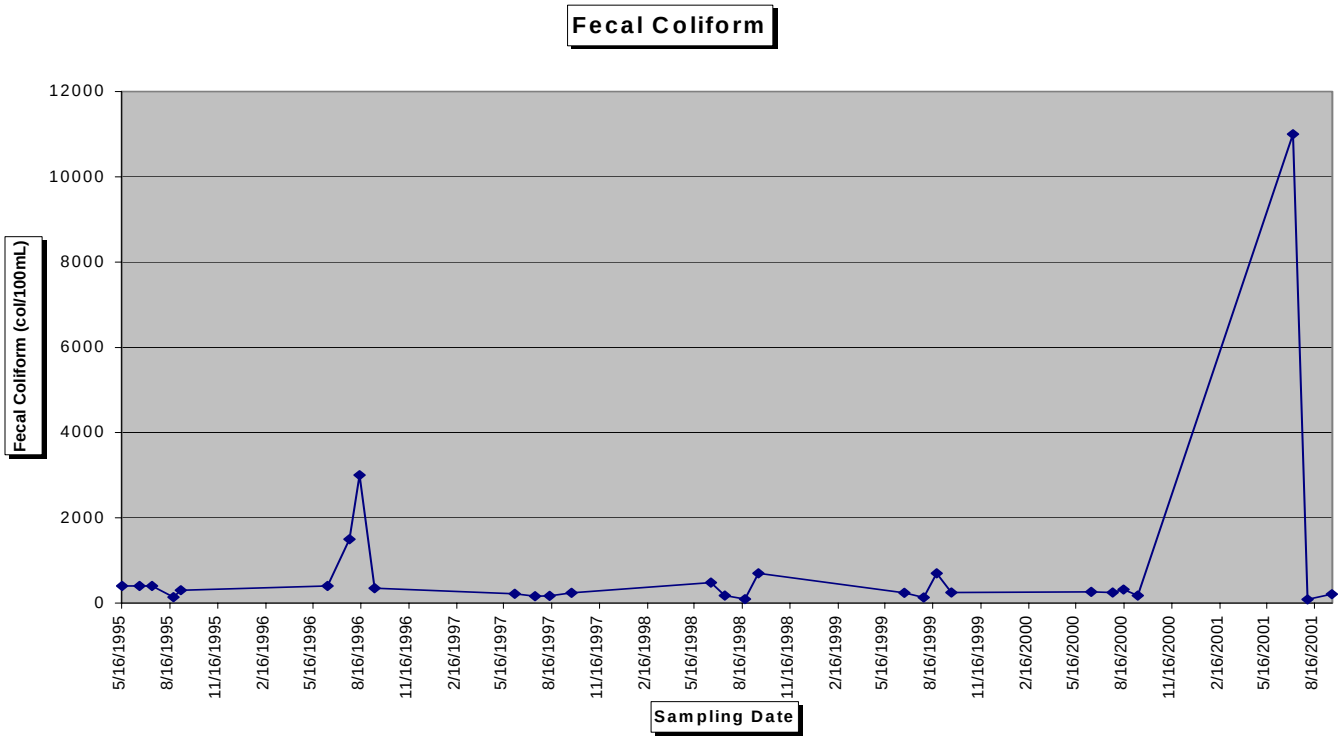
Another bacterial organism historically used as an indicator of sanitary quality is fecal coliform. The CT DEP abandoned fecal coliform as a water quality indicator in 2002 because some bacteria in this group can live and reproduce both in soil and water. The USGS water sampling data shows a drastic reduction in fecal coliform in the Pequabuck River since the mid 1980s, after upgrades done to the sewage treatment plants in the towns of Bristol, Plainville, and Plymouth. The following charts (Chart 3 and 3a) show the historical as well as current levels of fecal coliform present in the river.

Chart 3. Fecal Coliform Concentration*



Between 1995 and 2001, USGS data show that six out of 28 (21%) samples collected between the month of May 1 and October 1, during when disinfection is required for all wastewater, exceeded the Class B criteria for fecal coliform (400col/100mL for 10% of samples). The presence of fecal coliform bacteria in aquatic environments indicates that the water may have been contaminated by point or nonpoint sources of human and animal

Chart 3a. Recent Years Fecal Coliform Concentration



*--Fecal coliform data obtained from USGS Water Quality Sample Data from the Farmington Gauging Station, Connecticut.

waste. Although fecal coliform levels in the Pequabuck River have been drastically reduced over time, recent E.coli and enterococci data still indicate fecal contamination.

Nutrients that contribute to river pollution are nitrogen and phosphorous. Surface runoff, runoff from farmlands, and wastewater, are the major contributors of high nutrients to a river.

Phosphorous is identified as the nutrient responsible for the growth of algae and eutrophication[2] of fresh waterbodies. CT DEP Water Quality Standard number 19 (CT DEP 2002) requires the use of Best Management Practices and other reasonable controls

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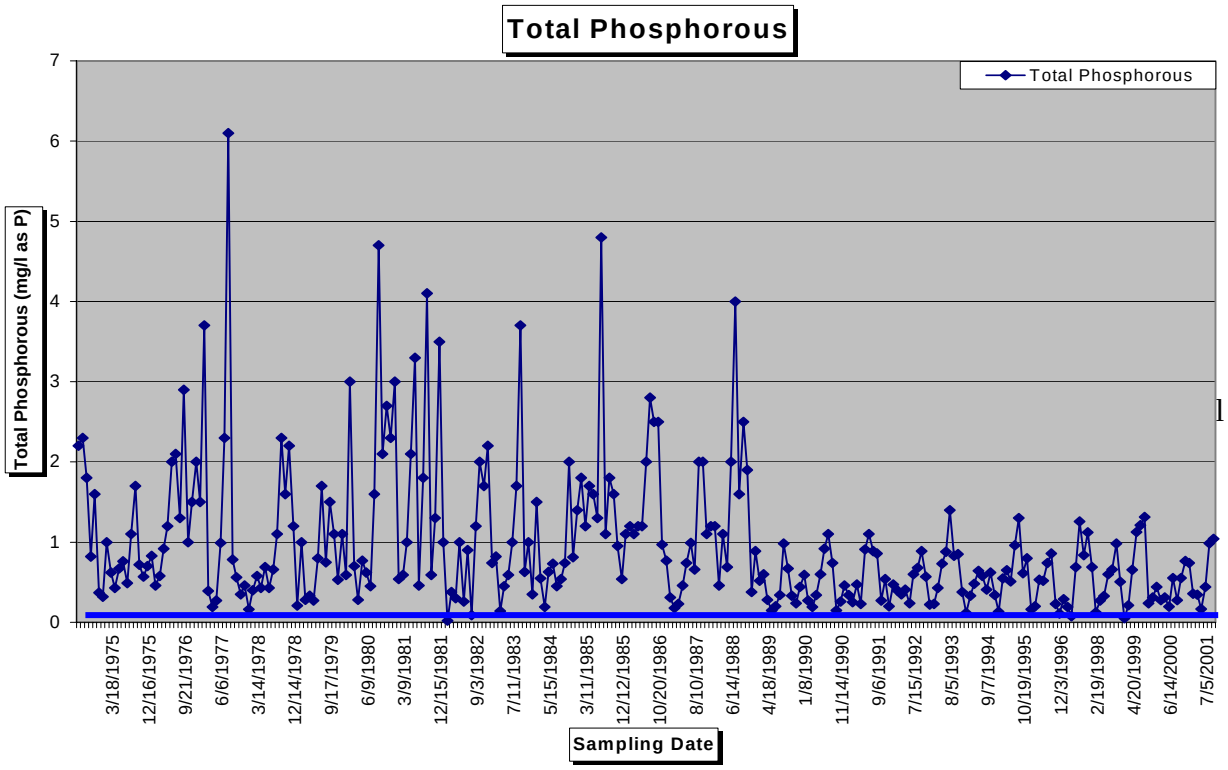
[2] Eutrophication: A process by which a water body becomes rich in dissolved nutrients, often leading to algal blooms, low dissolved oxygen, and changes in community composition. Eutrophication occurs naturally, but can be accelerated by human activities that increases nutrient inputs to the water body.

of non-point sources of nutrients and sediments for the correction of eutrophic conditions and to ensure the maintenance and attainment of existing and designated uses.

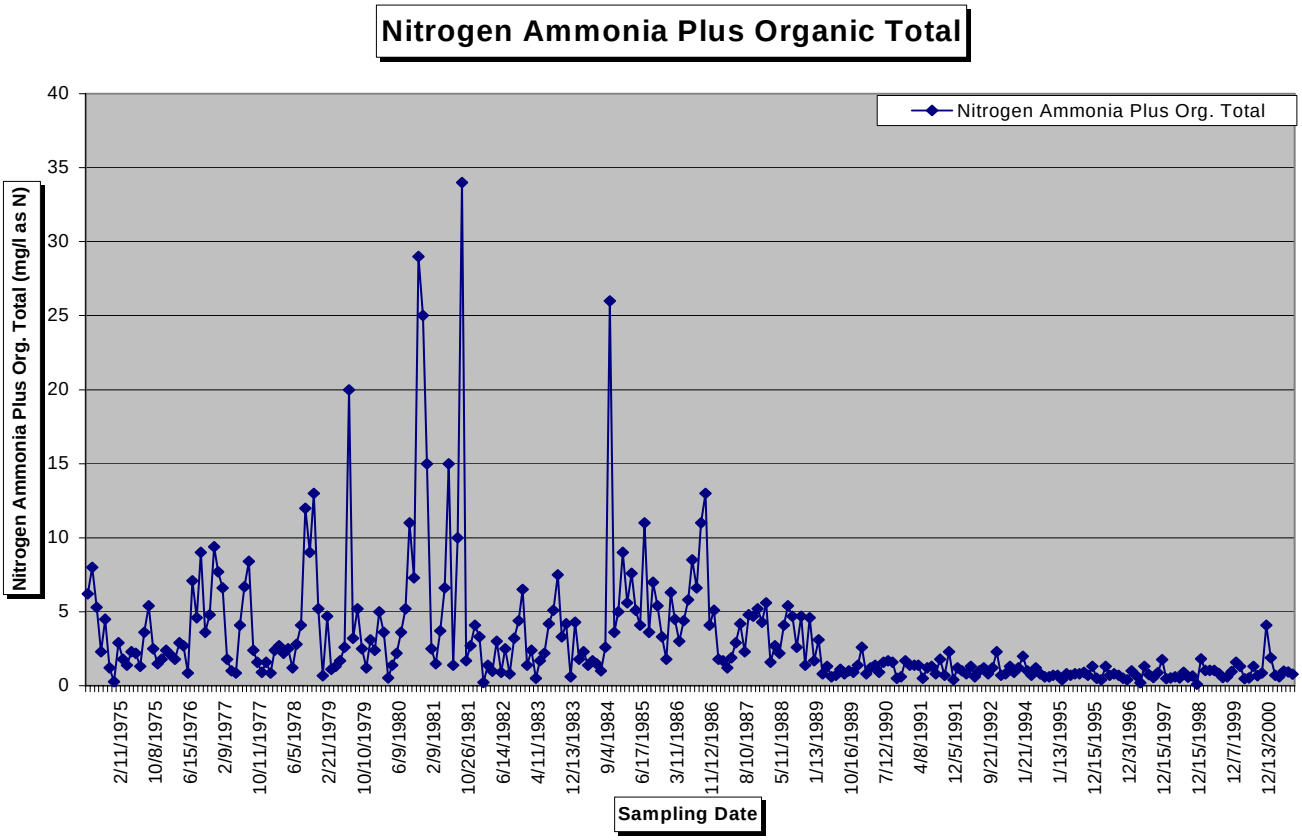
Recent water sampling in the Pequabuck River shows a significant amount of phosphate concentration in the water (Appendix A). Although the State of Connecticut and US EPA have not set specific water quality criteria for phosphorous, because the natural concentration of phosphorous varies greatly from one aquatic system to another, a general EPA standard of 0.1mg/l of total phosphate (Connecticut River Watch Program 2002) is taken as an allowable limit to prevent and control the eutrophication of waterbodies. The average phosphorous concentration in the Pequabuck River between 1995 and 2001 was 0.55mg/l, and the sampling done in the summer of 2002 showed an average concentration of 0.67mg/l. High concentrations of phosphorous may have impacts on aquatic life in the river, especially under low flow conditions and low gradient sections where algae growth and eutrophication can occur. Although phosphorous is elevated, there has been a significant reduction in phosphorous over time. Looking at the historical data collected at the USGS Gauging Station at Farmington, Connecticut, very high phosphorous loading was recorded until the late 1980s when, starting late 1988 to early 1989, the amount of phosphorous was drastically reduced in the river. The following chart (Chart 4), based on the data obtained from USGS Farmington Gauging Station, provides the trend of phosphorous concentration in the Pequabuck River.

Chart 4. Phosphorous Concentration



Nitrogen is also present in high quantities in the Pequabuck River. The water sampling done by the Connecticut River Watch Program last summer showed an increase in nitrate along the course of flow. Many points in the river upstream from downtown Bristol showed a lower concentration of nitrate, within the limit of Class A water (<2.0mg/L) but the concentration generally increased downstream of Memorial Boulevard in Bristol (Appendix A). Chart 5 based on the USGS data, shows the total organic nitrogen level in the Pequabuck River.

Chart 5. Nitrogen (Ammonia plus Organic Nitrogen Total)



Charts 4 and 5 show a drastic reduction in phosphorous and nitrogen concentration in the Pequabuck River since the later 1980s. The main reason for nitrogen reduction is the upgrade and improvement in the sewer treatment processes in the Water

Pollution Control Facilities located in the watershed towns of Bristol, Plainville, and Plymouth. The improvement in phosphorous loading could be attributed to the elimination of phosphorous from household use such as detergents. The current amount of phosphorous and nitrates in the effluent that discharges into the Pequabuck River from the three Water Pollution Control Facilities (WPCFs) ranges between 2-3 mg/l and 3-14 mg/l respectively. Although these amounts are within CT general permit, they may cause enrichment of water in the river. Nutrient levels in the Pequabuck River suggest the need for more efforts by all sides to further reduce nitrogen loading in the River.

The following table (Table 5) shows the amount of nitrogen and phosphorous in the effluent from the three Water Pollution Control Facilities (WPCFs).

Table 5. Nutrients in the Effluent from WPCFs

									Nutrients in mg/l
	Total Phosphorous			Nitrite			Nitrate		
Date	BR*	PN*	PY*	BR	PN	PY	BR	PN	PY
Jun-03	1.70	3.21	1.98	0.15	0.07	0.370	8.30	13.50	2.86
May-03	2.00	2.98	2.53	0.08	0.10	0.380	11.15	15.90	3.10
Apr-03	1.30	2.45	3.60	0.28	0.10	0.600	6.82	13.50	3.10
Mar-03	1.89	2.80	3.20	0.86	0.10	0.480	4.00	14.50	1.22
Feb-03	2.40	3.08	1.15	2.72	0.09	0.510	4.16	17.71	4.80
Jan-03	1.70	2.50	2.50	3.13	0.06	0.005	4.39	13.90	2.90
Dec-02	3.40		2.80	2.91		0.005	3.40		6.50
Nov-02	2.45		1.90	0.64		0.005	9.25		4.80
Oct-02	3.40		4.30	0.20		0.005	13.40		1.12
Sep-02	3.48		5.20	0.09		0.220	13.98		11.00
Aug-02	3.24		5.20	0.10		0.005	14.03		13.30
Jul-02	3.41		5.50	0.02		0.005	10.00		9.60
Jun-02			4.30			0.005			5.7

*--BR-Bristol WPCF; PN-Plainville WPCF; PY-Plymouth WPCF

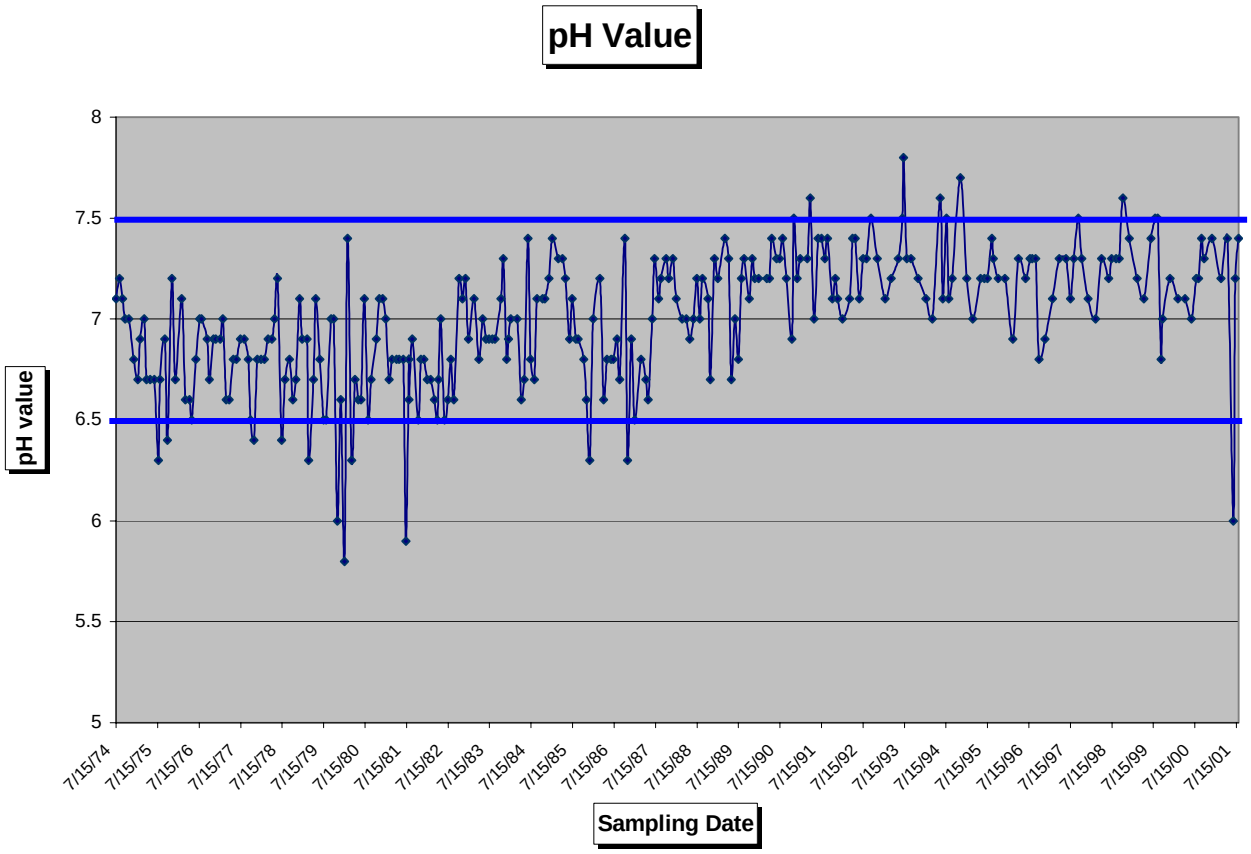
Other water quality indicators such as turbidity, pH, dissolved oxygen, and temperature, are given below in chart format. Dissolved oxygen (DO) refers to the

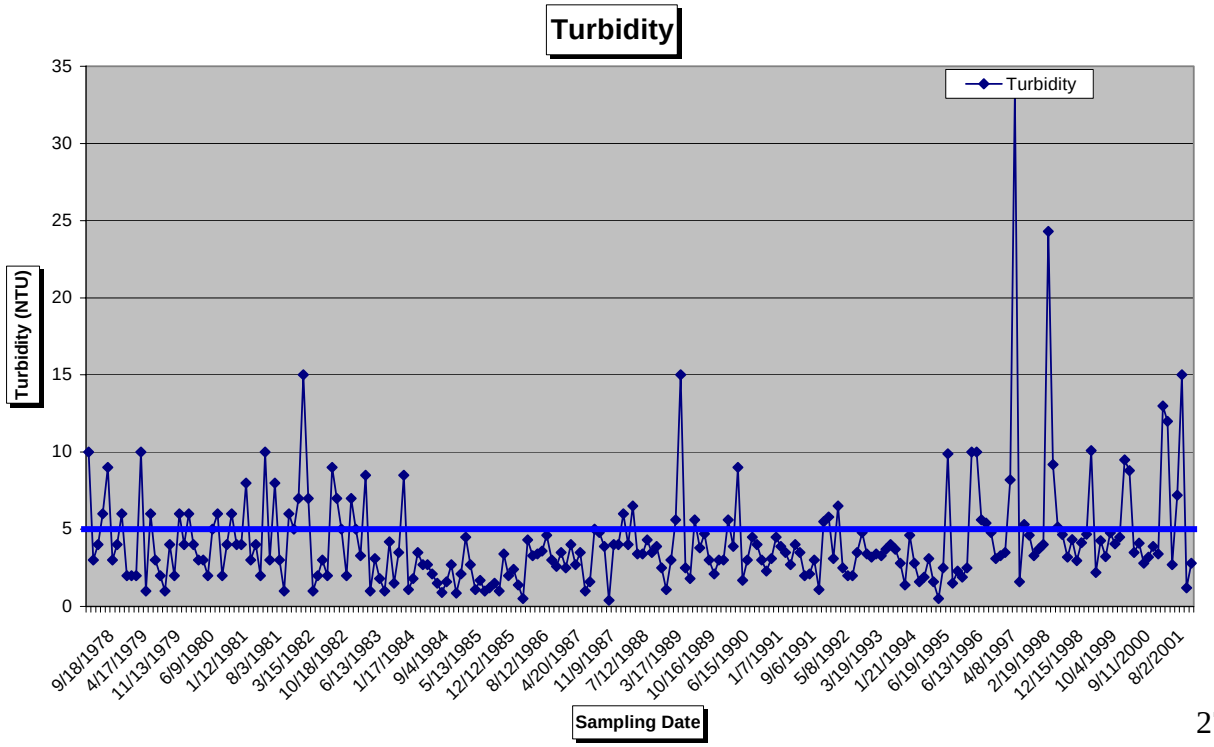
volume of oxygen that is contained in water. Dissolved oxygen concentration is an important indicator of habitat quality and ecosystem condition. Many chemical and biological reactions in ground water and surface water depend directly or indirectly on the amount of oxygen present. Dissolved oxygen is necessary in aquatic systems for the survival and growth of many aquatic organisms (www.usgs.gov). The lowest acceptable levels of dissolved oxygen for cold water fish is 6mg/L and 7mg/L for spawning season. The introduction of excess organic matter may result in a depletion of oxygen from an aquatic system. Prolonged exposure to low dissolved oxygen levels (<5-6 mg/l) may increase organisms' susceptibility to environmental stresses. pH is the measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The scale is 0-14. A pH value between 6.5 and 7.5 is considered to be desirable. Extreme values on either side are detrimental to the water quality and organisms and fish survival. Another water quality indicator, turbidity, is a measure of the amount of light intercepted by a given volume of water due to the presence of suspended and dissolved matter and microscopic organism. Increasing the turbidity of the water decreases the amount of light that penetrates the water column. Turbid conditions may increase the possibility for waterborne disease as it may be composed of organic and/or inorganic constituents. High levels of turbidity are harmful to aquatic life. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU).

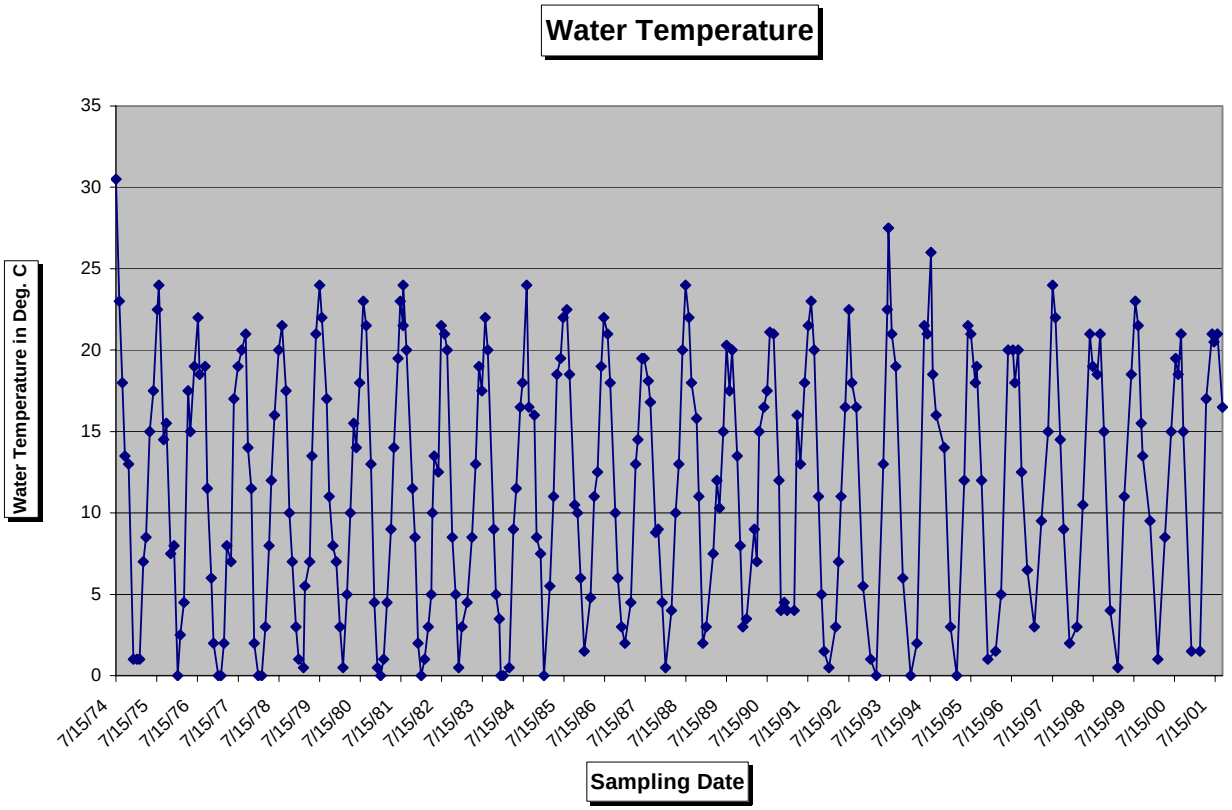
The following four charts present four different water quality indicators based on the sampling collected by the USGS in the Pequabuck River at the Farmington gauging station. The amount of dissolved oxygen (DO) has significantly improved since the late 1980s as a result of upgrade in water pollution control facilities. The reported pH values are within normal range. The temperature chart shows seasonal change in water temperature with no exceptional fluctuations. The turbidity chart shows few, sharp rises in turbidity values in recent years. Although the exact reason is undocumented, it is

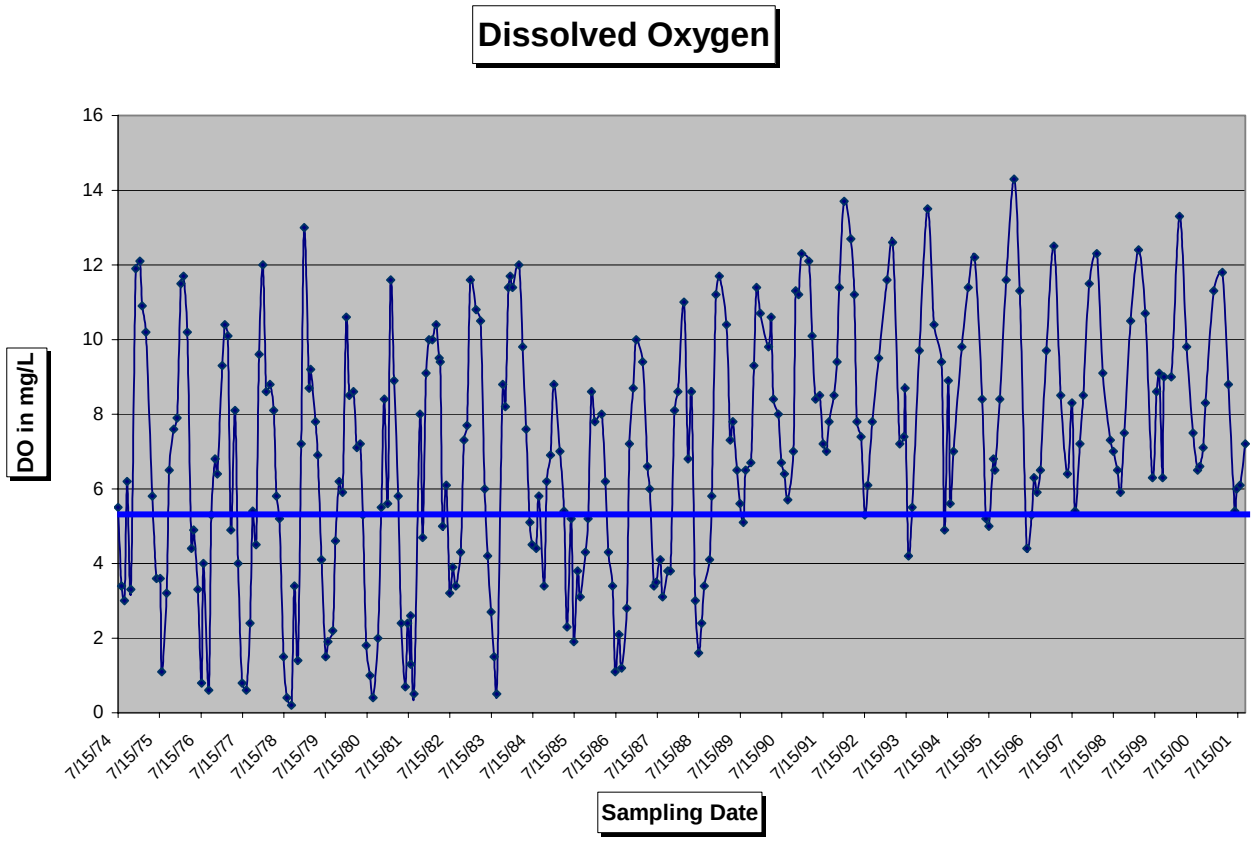
suspected that bridge construction, and mining activities may be responsible for those turbid conditions.

Chart 6. Water Quality Indicators






Water Temperature
Water Temperature in Deg. C
35
30
25
20
15
10
5
0
7/15/74
7/15/75
7/15/76
7/15/77
7/15/78
7/15/79
7/15/80
7/15/81
7/15/82
7/15/83
7/15/84
7/15/85
7/15/86
7/15/87
7/15/88
7/15/89
7/15/90
7/15/91
7/15/92
7/15/93
7/15/94
7/15/95
7/15/96
7/15/97
7/15/98
7/15/99
7/15/00
7/15/01
Sampling Date


Dissolved Oxygen
DO in mg/L
16
14
12
10
8
6
4
2
0
7/15/74
7/15/75
7/15/76
7/15/77
7/15/78
7/15/79
7/15/80
7/15/81
7/15/82
7/15/83
7/15/84
7/15/85
7/15/86
7/15/87
7/15/88
7/15/89
7/15/90
7/15/91
7/15/92
7/15/93
7/15/94
7/15/95
7/15/96
7/15/97
7/15/98
7/15/99
7/15/00
7/15/01
Sampling Date

The CT DEP maintains a database of water quality and designated uses of monitored streams and rivers in the state for reporting required under Section 305(b) of the federal Clean Water Act. For this purpose, the Pequabuck River has been broken into six segments and assessed for meeting its designated uses. The following table (Table 6) provides a synopsis of each segment and its condition as assessed by CT DEP:

Table 6. Pequabuck River and Coppermine Brook Segment Assessment Data*

Segment	Overall Use Support	Aquatic Life Support	Fish* Consumption Support	Primary Contact (Recreation)	Aesthetics	Potential Causes of Impairment	Potential Sources of Impairment
Peq_1	not supporting	partially	fully	not supporting	N/A	pathogens, indicator bacteria, turbidity and causes unknown	municipal point sources, urban runoff/storm sewers
Peq_2	not supporting	not supporting	fully	not supporting	Not supporting	unionized ammonia, pathogens, turbidity, and causes unknown	industrial point sources, municipal point sources, urban runoff/storm sewers
Peq_3	partially	partially	fully	fully	N/A	metals, zinc and some causes unknown	industrial point sources, municipal point sources, urban runoff/storm sewers and some sources unknown
Peq_4	not attainable	not attainable	fully	not attainable	N/A	other habitat alterations	hydromodification, channelization
Peq_5	threatened	threatened	fully	threatened	N/A	pathogens, indicator bacteria and some unknown causes	industrial point sources, municipal point sources, urban runoff/storm sewers, resource extraction, surface mining, land disposal, landfills
Peq_6	threatened	threatened	fully	threatened	N/A	causes unknown	source unknown
Copper-mine_1	not supporting	threatened	fully	not supporting	N/A	pathogens, indicator bacteria and some causes unknown	collection system failure and some source unknown
Copper-mine_2	not assessed	fully	fully	not assessed	N/A	-	-

*--There is a statewide health advisory on Connecticut's fish consumption for all type of fish except trout.

Segment Locations:

Peq_1: From mouth at Farmington River to RR crossing (south) of RT 72, Plainville.

Peq_2: From RR crossing, south of RT 72, Plainville to Bristol WPCF outfall.

Peq_3: From Bristol WPCF outfall to exit of box culvert, downtown Bristol.

Peq_4: From exit of box culvert to entrance of box culvert, center of Bristol.

Peq_5: From entrance to box culvert, center Bristol to Plymouth WPCF.

Peq_6: From Plymouth WPCF to headwaters.

Coppermine_1: From mouth at Pequabuck River to New Britain drinking water watershed boundary and water diversion (just upstream of confluence with Polkville Brook).

Coppermine_2: From drinking water watershed boundary and water diversion to headwaters (confluence of Whigville and Wildcat brooks).

*--Data obtained from CT DEP Water Quality Report to Congress 2002.

Table 6 shows that most assessed segments of the Pequabuck River and segment of Coppermine Brook are not fully supporting their designated uses. Identified causes include bacteria, pathogens, turbidity, and other unknown causes. Industrial point sources, municipal point sources, urban runoff/storm sewers, and landfills in the town of Plainville, along with various non-point sources are some of the major potential sources of impairment. Both the Pequabuck River and Coppermine Brook, in all cases, are fully supporting of fish consumption. There is a statewide health advisory on Connecticut's fish consumption for all type of fish except most trout, however. Most freshwater fish in Connecticut contain enough mercury to warrant limited consumption.

On-going Pollution Clean-up

Pollution in the river not only affects water quality but also the health of fish and wildlife, and the drinking water supply of watershed communities. Any contamination in the river may affect the groundwater in the area, which will have direct impact on the people who depend on well water. Old and leaking pipelines carrying sanitary sewage and other illicit discharges, illegal dumping and improper storage of hazardous materials, and improper use and disposal of pesticides, may also contaminate waterbodies either by infiltrating into the groundwater, by discharge to surface waterbodies, or by stormwater runoff during precipitation events. It is very important to monitor and immediately clean up any hazardous and harmful substances to prevent them from being discharged to the river. It is a tedious process to monitor non-point sources such as stormwater runoff into the river. However, careful and frequent monitoring of the river and periodic sampling may provide indications of potential contaminants in the water.

The New England Regional Office of the U.S. EPA has identified 32 hazardous waste disposal sites or Superfund sites within the Pequabuck River watershed. Many of these sites are cleaned and currently unused, and some are going through the clean up process or awaiting a NPL (National Priority List) decision for clean up. Table 7 below provides a list of the hazardous waste disposal sites (http://www.epa.gov/ne/superfund/findsite/fndindex.htm) in the watershed.

Table 7. Superfund Sites in Watershed Towns and their Status

Count	City	Site Name	Site Type	Address	County
1	Bristol	Acme Rivet & Machine	RCRA	400 Middle Street	Hartford
2	Bristol	Bristol Franklin Street PCBs	SHORT	50 - 100 Franklin Street	Hartford
3	Bristol	Bristol Sanitary Landfill	RCRA	Lake Avenue	Hartford
4	Bristol	General Motors	RCRA	780 James P Casey Road	Hartford
5	Bristol	H.J. Mills Box Factory	BF	149-151 Church Street	Hartford
6	Bristol	Ivanhoe Corporation	SAND	16 Jeanette Street	Hartford
7	Bristol	J & S Metals	SAND	95 Wooster Court	Hartford
8	Bristol	Metal Finishing Technologies	RCRA	60 Wooster Street	Hartford
9	Bristol	North East Utilities	SAND	Riverside Avenue (Route 72)	Hartford
10	Bristol	Metal Finishing Technologies	RCRA	60 Wooster Street	Hartford
11	Farmington	Apex Machine and Tool Company	SAND	21 Spring Lane	Hartford
12	Farmington	Bauer Aerospace, Inc. (former)	SAND	126 Hyde Road	Hartford
13	Farmington	Connecticut Spring & Stamping Company	SAND	48 Spring Lane	Hartford
14	Farmington	Dayon Manufacturing, Inc.	SAND	1820 New Britain Avenue	Hartford
15	Farmington	Dell Manufacturing Company	SAND	Four Right Lane	Hartford
16	Farmington	Edmunds Manufacturing Company	SAND	45 Spring Lane	Hartford
17	Farmington	Electronic Coil Corporation	SAND	145 Hyde Road	Hartford
18	Farmington	Farmington Landfill II	SAND	Red Oak Hill Road	Hartford
19	Farmington	Fletcher-Terry Company	SAND	65 Spring Lane	Hartford
20	Farmington	Gros-Ite Industries, Inc.	SAND	1790 New Britain Avenue	Hartford
21	Farmington	J.F. Frederick Tool Company, Inc.	SAND	25 Spring Lane	Hartford
22	Farmington	Mallory Industries, Inc.	SAND	33 Spring Lane	Hartford

Count	City	Site Name	Site Type	Address	County
23	Farmington	New England Aircraft Plant #1	SAND	36 Spring Lane	Hartford
24	Farmington	New England Aircraft Plant #2	SAND	55 Spring Street	Hartford
25	Farmington	Roy Machinery and Sales	SAND	1810 New Britain Avenue	Hartford
26	Farmington	Whitnon-Spindle	SAND	1784 New Britain Avenue	Hartford
27	Plainville	American Tool and Manufacturing	SAND	71 Northwest Drive	Hartford
28	Plainville	Brown Manufacturing Company, Inc.	SAND	75 Northwest Drive	Hartford
29	Plainville	Esco Laboratories, Inc.	SAND	83 Northwest Drive	Hartford
30	Plainville	Mott Metallurgical Company	SAND	84 Spring Lane	Hartford
31	Plainville	Olson Brothers Company	SAND	272 Camp Street	Hartford
32	Plainville	Plainville Plating	RCRA	21 Forestville Avenue	Hartford

Long-Term Cleanup (NPL); Short-Term Cleanup (SHORT); Awaiting NPL Decision (SAND); RCRA Corrective Action (RCRA) Brownfields (BF). Data source: http://www.epa.gov/ne/superfund/findsite/fndindex.htm

River Cleanup Program

During the spring every year and occasionally in the fall, the Pequabuck River Watershed Association (PRWA) volunteers run a river cleanup program where they remove debris and trash from the river. The Farmington River Watershed Association, Bristol Chamber of Commerce, and GE Elfun Club, also assist this program by providing volunteers, collection bags and gloves. The PRWA also contacts CT DEP for river cleaning of any visible pollutants that may be dumped into the river or along the riverbank.

The following are the general and visual problems that can be seen along the Pequabuck River and its tributaries:

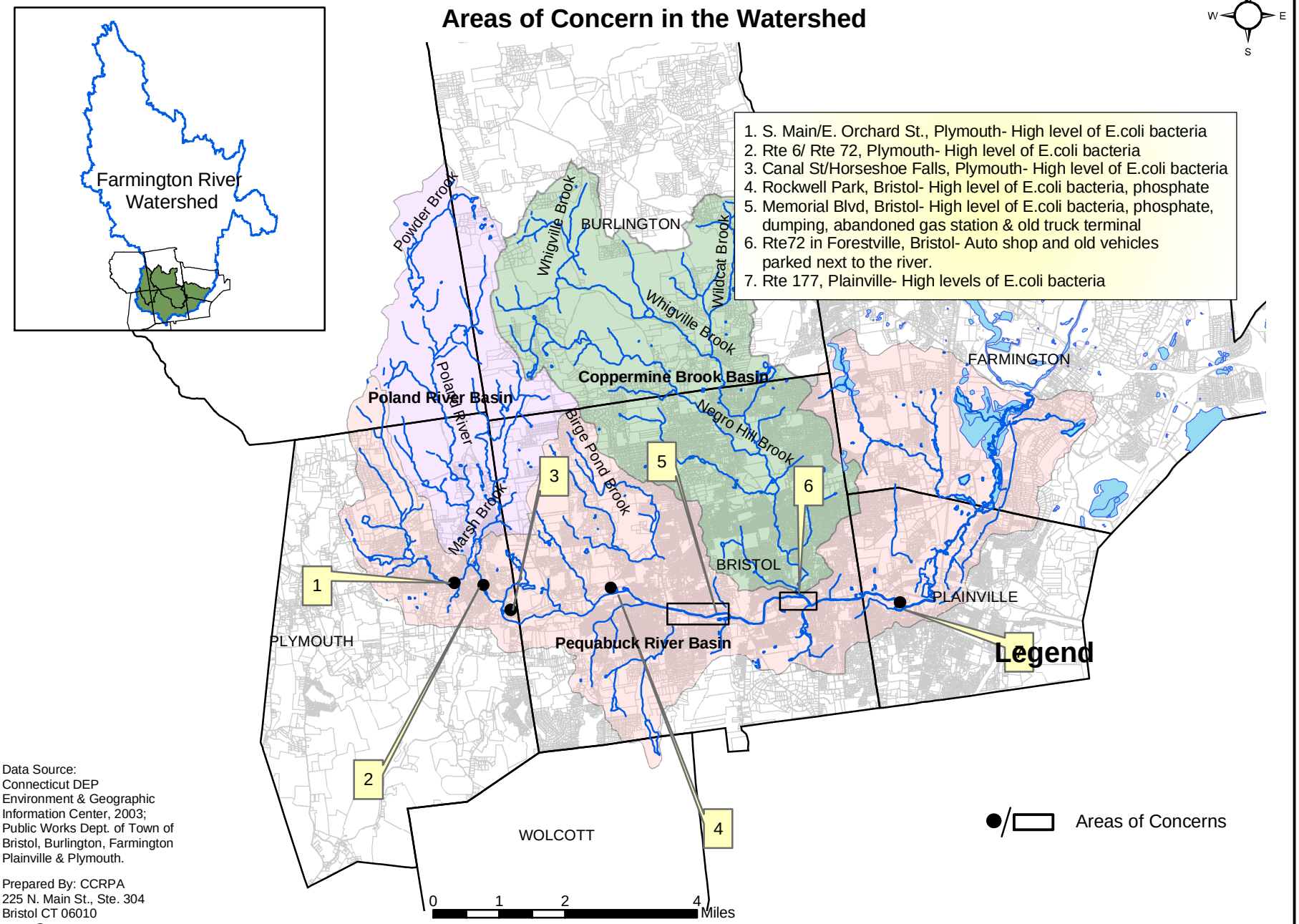
- Eroded stream banks
- Algae growth during low-flow periods
- Occasional dumping of garbage and other material such as shopping carts and other household goods
- Buildings built over the river channel which may subject the river to additional pollutants; affecting habitat and water temperature
- Inadequate stream buffers
- Many abandoned structures are located within 25 feet from the stream adversely impacting the aesthetics of river
- Dams and other structures such as paved riverbed built along or within river channel which obstruct movement of fish.

The quality as well as the appearance of the Pequabuck River has greatly improved since the upgrade of the three sewage treatment facilities in the watershed. Advance Waste Treatment (AWT) was installed at the Bristol water pollution control facility in 1988, at Plainville in 1981, and at Plymouth in 1991. All three facilities are currently meeting the wastewater treatment demand.

Although the water quality has improved, many challenges remain ahead. Many sections of the Pequabuck River are listed as impaired because they are not fully supporting of their designated uses. There are several reasons associated with the impaired quality of water in the river. The impervious surfaces of the dense development in watershed towns facilitate runoff to storm drains that ultimately discharge to the river. There is, therefore, a high risk of the inflow of pollutants such as chemicals used in lawns and gardens, as well as storm water collecting materials from these areas. The threat of inflow of sewage to the river also has not been completely eliminated as parts of watershed towns still use individual septic system for sewage disposal. Old and failing septic systems may leak effluent, which can contaminate river water. A separate sanitary survey needs to be conducted to assess the threat of septic contamination to the river. The following map (Map 4) shows areas of concern in the watershed. These areas either have high E-coli bacteria and nutrients, or hazardous substance such as oil and gasoline.

Map 4. Pequabuck River Watershed

Areas of Concern in the Watershed



Data Source:
Connecticut DEP
Environment & Geographic
Information Center, 2003;
Public Works Dept. of Town of
Bristol, Burlington, Farmington
Plainville & Plymouth.

Prepared By: CCRPA
225 N. Main St., Ste. 304
Bristol CT 06010
ccrpa@ccrpa.org www.ccrpa.org

Water Quantity

The Pequabuck River Watershed is a subregional watershed of the Farmington Regional Basin and is comprised of two subregional drainage basins, Poland River and Coppermine Brook, along with several other feeder brooks and streams. The sources of these tributaries are stormwater runoff and groundwater discharge from hillside seeps, springs, and wetlands. Although flow of the Pequabuck River varies significantly seasonally, the mean daily streamflow averages about 81 cubic feet per second (cfs). However, at different times very high flows were recorded. A peak flow of 11,300 cfs and 6,630 cfs were recorded on August 19, 1955 and Sept 16, 1999, respectively (USGS). Chart 8 and 8a show the mean monthly and peak flow in the Pequabuck River recorded at the USGS Forestville Gauging Station. Chart 7 and 8 show that high flows in the river coincide with the high rainfall and vice versa. In the year 1965, when the annual precipitation was only 30.98 inches, the mean monthly flow in the river diminished to 18 cfs comparing to the average flow of 81 cfs. In essence, precipitation is the dominant factor in the Pequabuck River flow.

The Pequabuck River itself has not been used as a potential source of drinking water supply in the region. Its tributaries Poland River and Coppermine Brook, however, feed different water supply reservoirs. The Pequabuck River serves as a water source for various industrial and recreational purposes. There are various water diversion permits and registered diversions in the three-basin watershed (Appendix B). They either divert water from the Pequabuck River, its tributaries, or draw water from the aquifers located in the watershed.

Chart 7. Annual Rainfall in Connecticut, 1940-2002

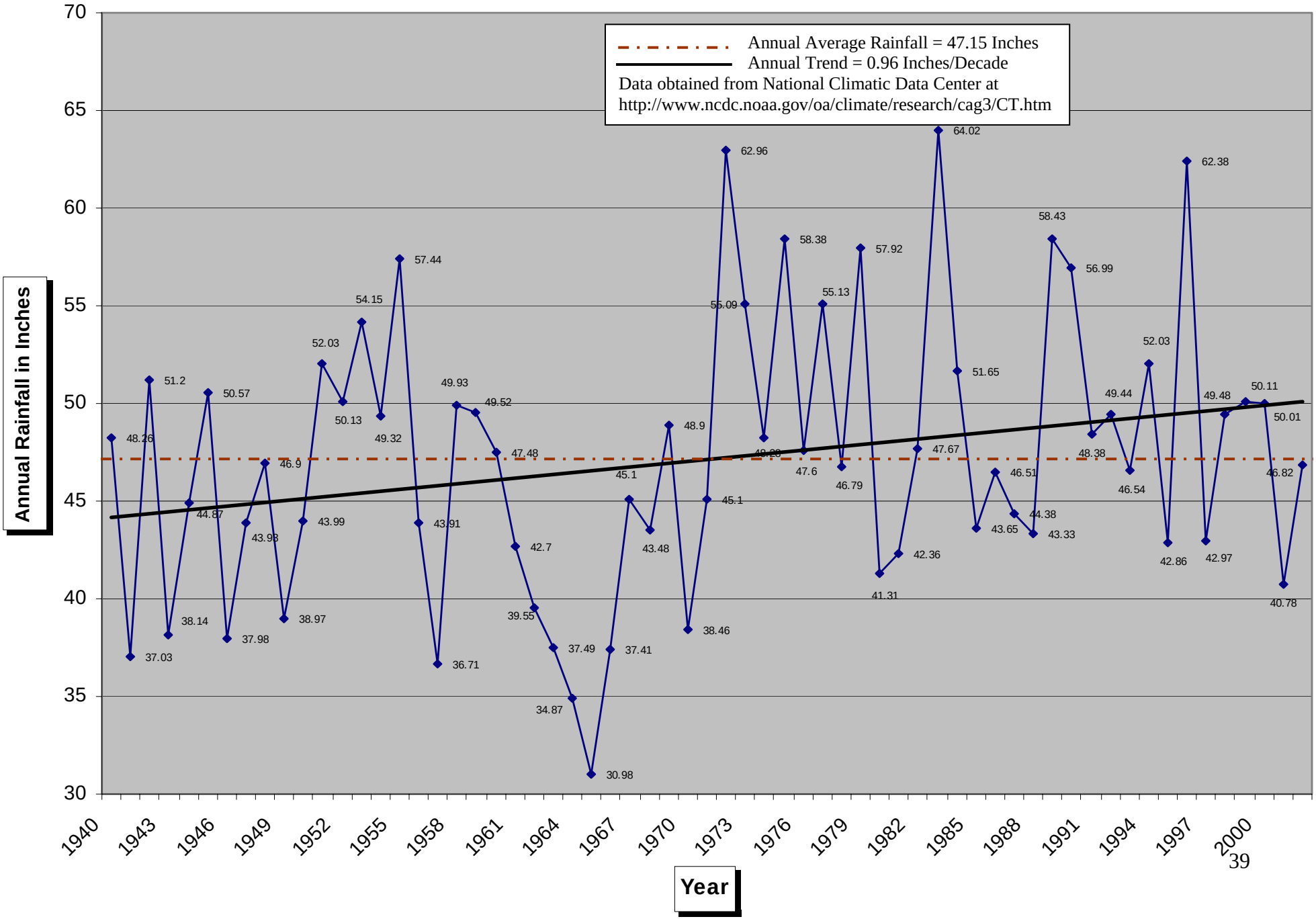


Chart 8. Mean Monthly Flow

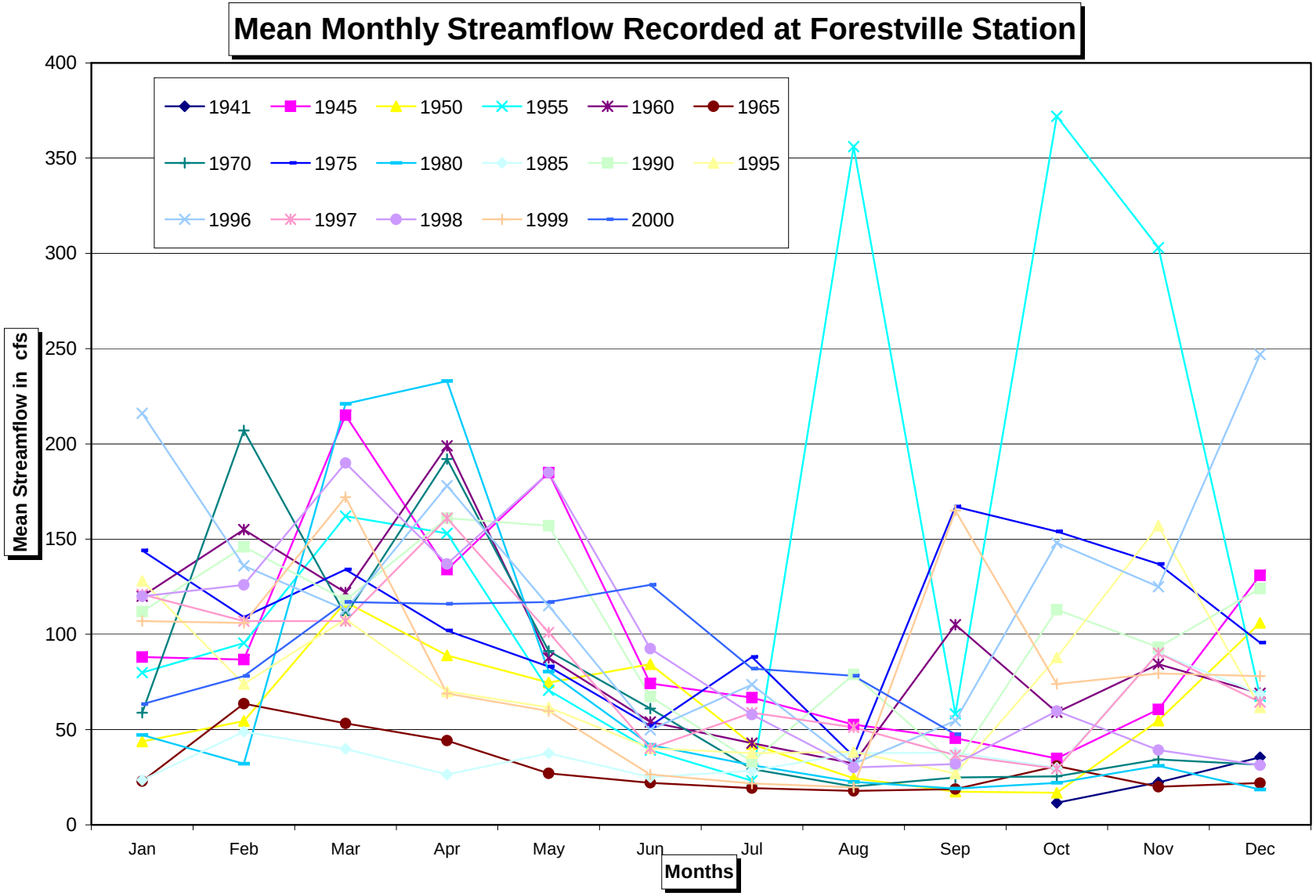
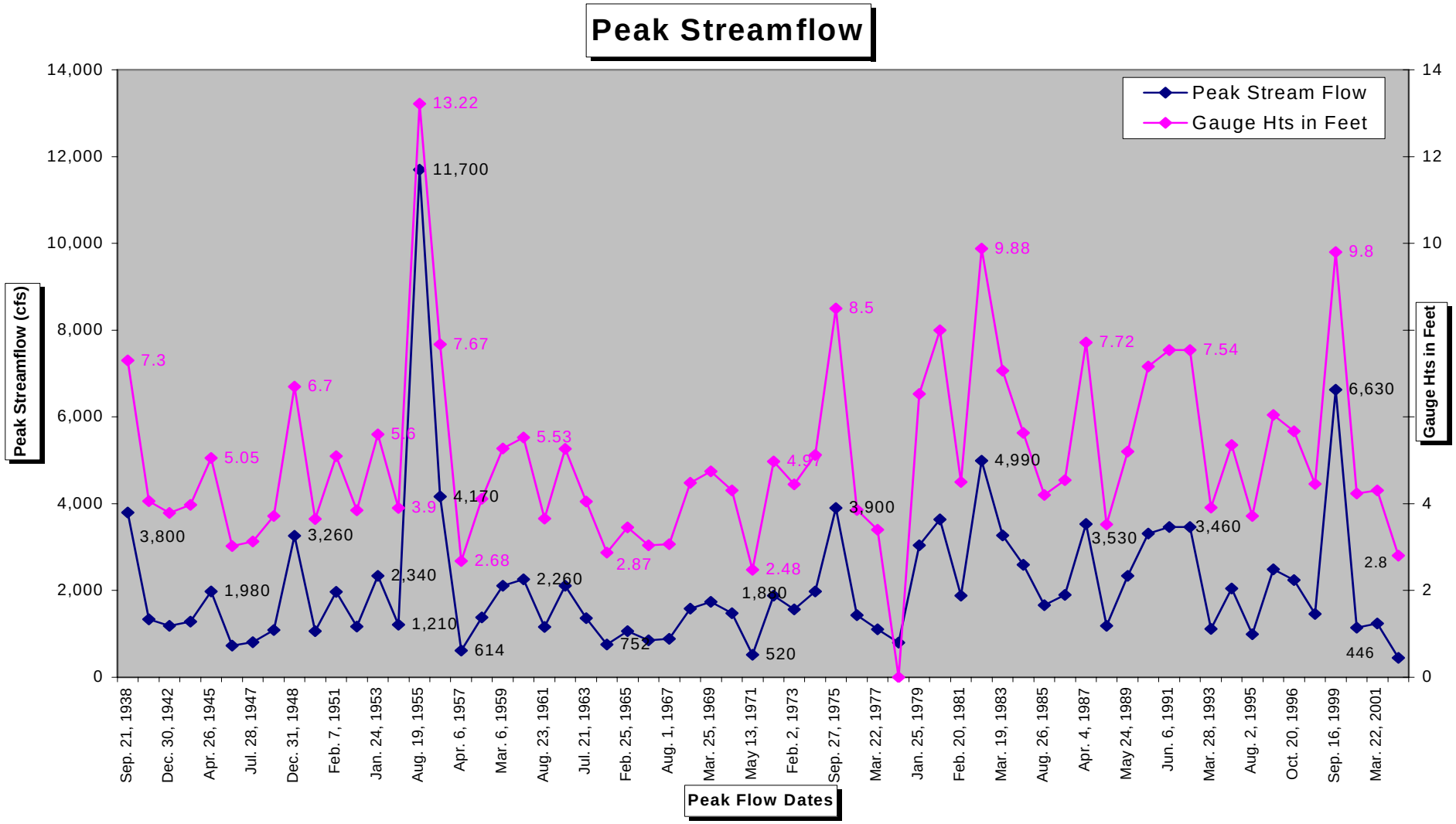


Chart 8a. Peak Streamflow



Water Diversions

The Bureau of Water Management's Inland Water Resources Division regulates activities such as the withdrawal, alteration, modification or diminution of, the instantaneous flow of the waters of the state. Water diversions are generally classified into two categories—consumptive and non-consumptive. In general, a permit is required to conduct activities which result in the alteration of surface water flows, and withdrawals of surface and ground water exceeding 50,000 gallons per day. Diversions existing on or before July 1, 1982, which were registered with CT DEP on or before July 1, 1983, are considered to be registered in accordance with the Water Diversion Policy Act, 1982. These users do not require CT DEP authorization to withdrawal water.

After the implementation of the Connecticut Water Diversion Policy Act, all water withdrawals greater than 50,000 gallons per day after July 1, 1983 require a permit and consequently must undergo an environmental review process. When making a decision on a water diversion permit application, CT DEP must consider the environmental effects of the diversion and determine whether the proposed diversion is necessary (http://www.dep.state.ct.us/pao/IWRDfact/waterdiv.htm). Appendix B shows a list of diversions in the Pequabuck River Watershed.

Based on the information provided by CT DEP, there are 28 registered and 8 permitted diversions in the Pequabuck River, Poland River and Coppermine Brook. Of the 36 diversions, 24 are consumptive and 12 are non-consumptive. The non-consumptive diversions include physical alterations such as relocation of river channel and stormwater detention facilities, whereas consumptive uses are withdrawals of water for supply. Under the Connecticut Water Diversion Policy Act to divert or withdraw

water from rivers/aquifers, the following parties have registrations: Bristol Water Dept., New Britain Water Dept., Chippanee Golf Club, Connecticut Water Company, Town of Farmington, and Trumpf America, Inc.. Beside registered users, there are several other permitted diversions in the area. Four out of the eight diversion permits have expired and their current status is unknown.

Drinking Water Supply

As stated earlier, there are currently three major water utilities, Bristol Water Dept., New Britain Water Dept., and Connecticut Water Company, that are withdrawing surface as well as groundwater from the watershed area. The following table (Table 8) provides a synopsis of average daily water consumption.

Table 8. Average Daily Water Consumption*

Water Department	Withdrawal Type	Basin	Purpose	Average Daily Consumption (mgd)
City of Bristol	Reservoir & wells	Coppermine, Pequabuck & Poland	Public Water Supply	4-5
City of New Britain	Reservoir & wells	Coppermine	Public Water Supply	10.5
Connecticut Water Company	Reservoir & wells	Pequabuck & Poland	Public Water Supply	0.49

*-- *Data Source: Water Departments of the Town of Bristol, Plainville, and Plymouth..*

Dams and Impoundments

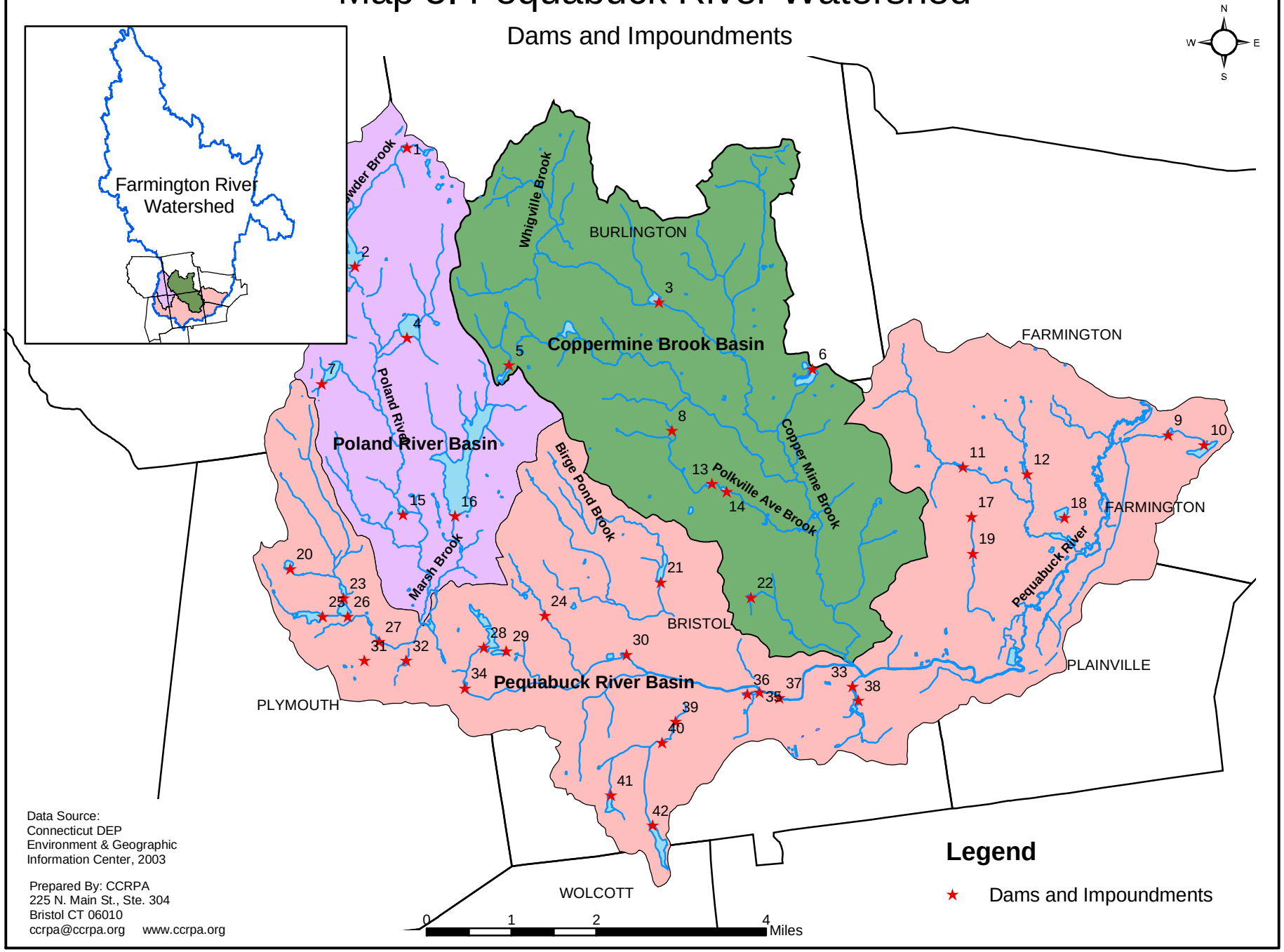
There are altogether 42 impoundments and lakes in the watershed. Many of them are used for the purpose of water storage for drinking water supply. Bristol Reservoir #1-#5, Old Marsh Pond (Bristol Reservoir #7), Poland Brook (Bristol Reservoir #6), Terryville Reservoir, and Whigville Reservoir, are some of the major water storage

reservoirs in the watershed. These waterbodies have added aesthetics to the area as well as habitat for various animals and birds. Similarly, they also provide protection during large floods by regulating water. At the same time, however, they alter the river system and aquatic life. Dams built along the rivers obstruct the upstream movement of fish. Examples of such dams in the watershed are Horseshoe Falls Dam, and Bristol Brass Dam to name a few. The following map (Map 5) and table (Table 9) list dams and impoundments, associated streams/lakes, and their water quality. The current status and operation of some of these dams are unknown.

A major concern about the water withdrawal in the Pequabuck River Watershed, is the inherent relationship between river flow and groundwater. Excessive water withdrawals from a watershed become problematic if the stream flow diminishes to very low levels. During low-flow conditions when recharge is very little, excessive water withdrawals may cause the flow to be too shallow to support some aquatic species, and impair fish movement. Similarly, during low-flow conditions nutrient levels may rise and create an unhealthy river environment due to lack of dilution.

Map 5. Pequabuck River Watershed

Dams and Impoundments



Data Source:
Connecticut DEP
Environment & Geographic
Information Center, 2003

Prepared By: CCRPA
225 N. Main St., Ste. 304
Bristol CT 06010
ccrpa@ccrpa.org www.ccrpa.org

Table 9. Dams and Impoundment in the Pequabuck River Watershed*

Dam ID	Dam Or Impoundment Name	Associated Stream Name	Associated Lake	Water Quality	Ownership
1	Hogan Brothers Dam	Powder Brook	Hogan Brothers Dam	AA	Mountain Meadows Corporation
2	Bristol Reservoir Dam #4	Poland River	Bristol Reservoir No 4	AA	Bristol Water Dept.
3	New Britain Reservoir Dam	Whigville Brook	Whigville Reservoir	AA	New Britain Water Dept.
4	Bristol Reservoir Dam #5		Bristol Reservoir No 5	AA	Bristol Water Dept.
5	Country Pond Dam		Country Pond	AA	Burlington Land Trust Inc.
6	Lake Como Dam		Lake Como	AA	Frank Pugliese
7	Bristol Reservoir Dam #2		Bristol Reservoir No 2	AA	Bristol Water Dept.
8	Hershman Pond Dam	Unknown Stream			City of Bristol-Stormwater Trust
9	Walters Pond Dam		Curtains Pond	A	Joan Dalberg
10	Farmington Reservoir Dam		Wadsworth Reservoir	AA	Town of Farmington
11	Roberts Pond Dam	Scott Swamp Brook	Bryant Pond	A	Jeffery J. Mita
12	Dot Pond Dam		Taplin Pond	A	CT DEP
13	Polkville Brook Dam	Polkville Ave Brook	Polkville Brook Dam	AA	CT DEP
14	Hay Bale Check Dam(Breached)	Polkville Ave Brook	Nelsons Pond	AA	CBT/IN Trust for A.W. Bartholomew
15	Bristol Reservoir Dam #3	Poland River	Bristol Reservoir No 3	AA	Bristol Water Dept.
16	Old Marsh Pond Dam		Bristol Reservoir No 7	AA	Bristol Water Dept.
17	Farmington Chase Pond Dam	Unknown Stream			Farmington Chase Assoc. Inc.
18	No Dam				
19	Fleetwood Arms Dam		Fleetwood Arms Dam	A	Town of Plainville
20	Terryville Reservoir Dam #3		Terryville Reservoir No 3	AA	Connecticut Water Company
21	Birge Pond Dam	Birge Pond Brook	Birge Pond	A	City of Bristol-Parks Dept.

22 Page Park Pond Dam		Page Park Lagoon	A	City of Bristol-Parks Dept.
23 Upper Pond Dam	Pequabuck River	Upper Pond	A	Terryville Fish & Game Inc.
24 Kenneths Pond Dam		Kenneths Pond	A	Ellen Ferrier
25 Zeiner Pond Dam		Zeiner Pond	A	Town of Plymouth
26 Middle Pond Dam	Pequabuck River	Middle Pond	A	Terryville Fish & Game Inc.
27 Electro Dam(Breached)	Pequabuck River			
28 Bristol Reservoir Dam #1		Bristol Reservoir No 1	AA	Bristol Water Dept.
29 Nova Lake Dam		Nova Lake	AA	Bristol Water Dept.
30 Rockwell Park Pond Dam		Rockwell Park Pond	A	City of Bristol-Parks Dept.
31 Unnamed Dam				
32 Eugene Park Pond Dam		Eugene Park Pond	A	William Allread
33 Lower Malone Pond Dam		Lower Malone Pond	B/A	CT DEP
34 Dan Slevinsky Dam	Pequabuck River	Scott Pond	C/B	Dan Slevinsky
35 Memorial Park Pond Dam #1		Memorial Park Pond	A	City of Bristol-Parks Dept.
36 Memorial Park Pond Dam #2		Memorial Park Pond	A	City of Bristol-Parks Dept.
37 Bristol Brass Dam		Bristol Brass Co Pond	A	CT DOT
38 Malones Pond Dam		Malones Pond	B/A	City of Bristol-Parks Dept.
39 No Dam				
40 Fijol Pond Dam	South Mountain Brook	Fijol Pond	A	James Riquier
41 Indian Rock Pond Dam		Wallace & Barnes Pond	A	Bristol Regional Environmental Center
42 Jacklin Lake Dam		Dunham Millpond	A	Jacklin Rod & Gun CB

*--Data obtained from the CT DEP Water Bureau, Oct. 16, 2003..

Wastewater and Effluent Discharges

A National Pollutant Discharge Elimination System (NPDES) permit is required to discharge any effluent into the river. According to the permit, the average monthly effluent concentration shall not exceed 15% of the average monthly influent concentration for biochemical oxygen demand (5 day) (BOD5), and total suspended solids, for all daily composite samples taken in any thirty calendar day period. The permit also prohibits any new increased amounts of domestic sewage discharge to the sewer system where it will cause a dry weather overflow. Similarly, the NPDES permits also specifies that the temperature of any discharge shall not increase the temperature of the receiving stream above 85°F or, in any case, raise the normal temperature of the receiving stream more than 4°F.

At present, there are six NPDES permits issued for point source discharges to the Pequabuck River. Out of the six permits, three are for the effluent from Water Pollution Control Facilities (WPCF) for the Towns of Plymouth and Plainville, and the City of Bristol. The following map (Map 6) and table (Table 10) show the locations and type of various point source surface water discharges to the Pequabuck River. Map 7 and Table 11 show sewage facilities and coverage area in the watershed towns of Bristol, Plainville and Plymouth.

Map 6. Pequabuck River Watershed

Effluent Discharge Points

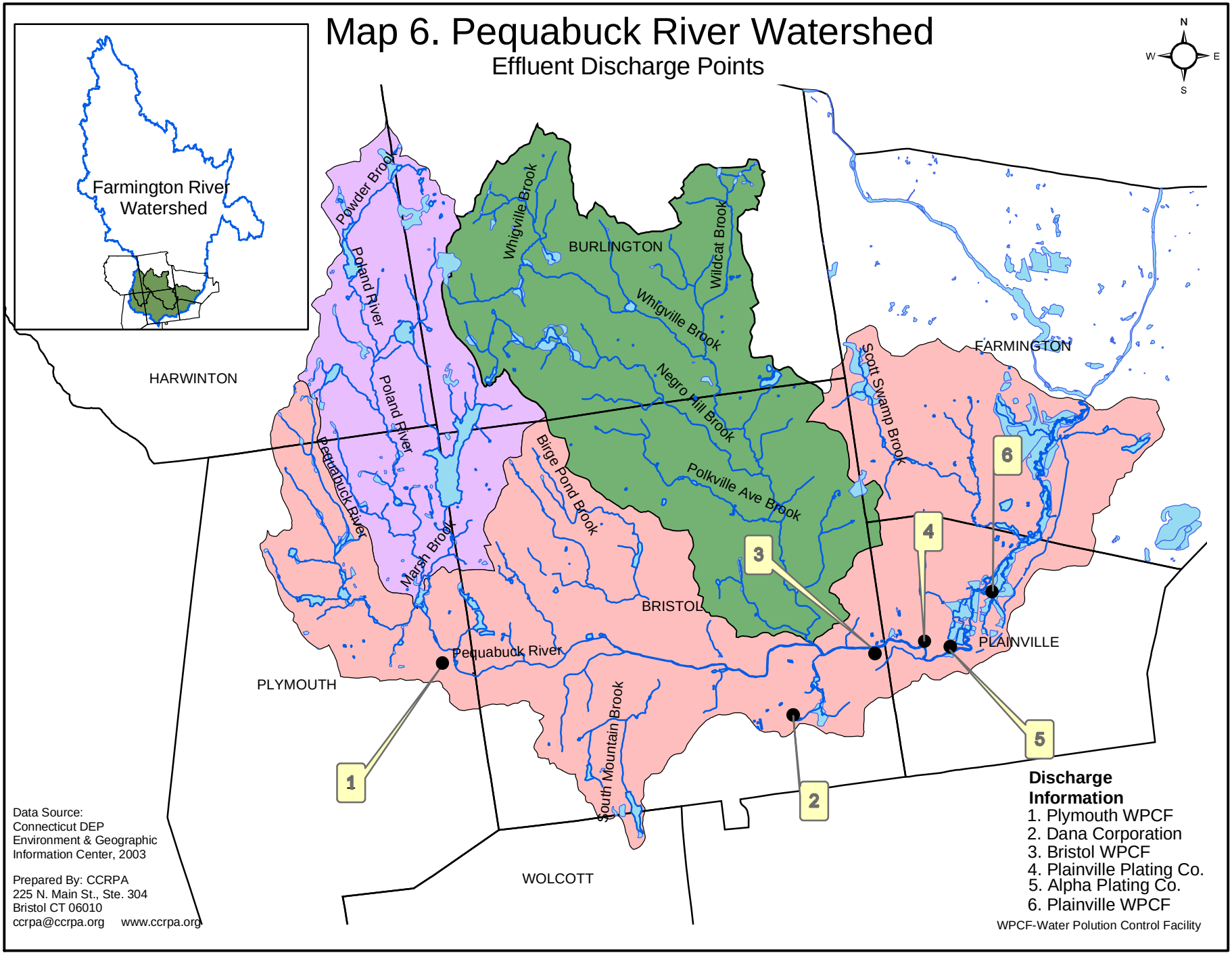


Table 10. Discharge into the Pequabuck River*				
Discharging Agency	**Permit Issued**	**Permit Expires**	**Type of Discharge**	**Design Flow Rate**
Bristol WPCF	04/03/01	04/03/06	Treated sewage effluent	10.75mgd
Plainville WPCF	06/15/00	05/15/05	Treated sewage effluent	1.75mgd
Plymouth WPCF	09/26/00	09/26/05	Treated sewage effluent	1.75mgd
Dana Corporation	04/01/99	04/01/04	Cooling water during summer	N/A
Alpha Plating & Finishing Co	07/15/98	07/15/03	Cooling water	N/A
Plainville Plating Company	04/01/98	04/01/03	Cooling water	N/A

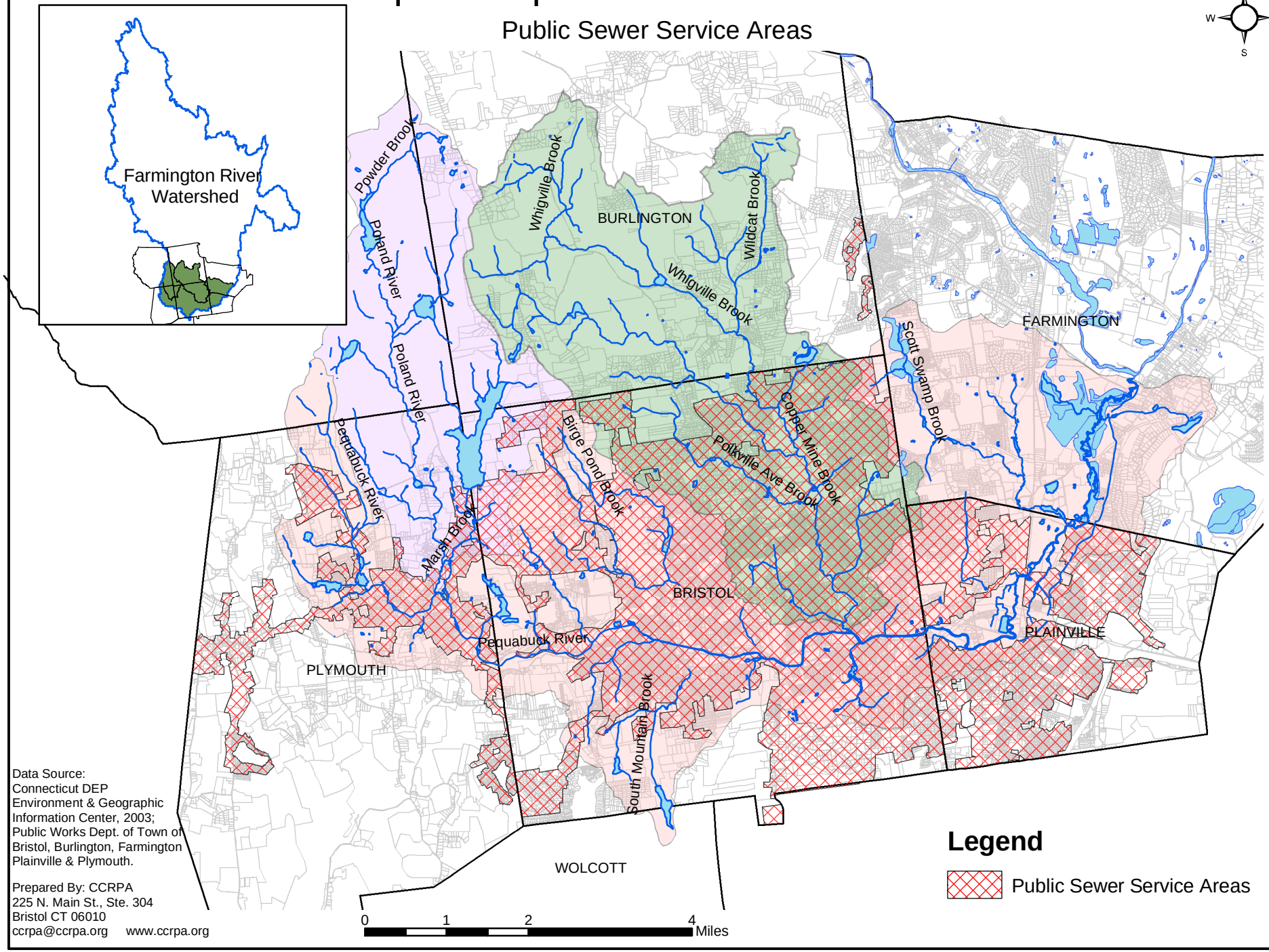
*--Data obtained from Dept. of Public Works of respective towns and CT DEP.

Table 11. Sewage Facilities in the Watershed Towns*						
Name	**Serving Town**	**Capacity/ Average Discharge**	**Discharge River**	**Sewered Household**	**Total Occupied Household (2000 Census)**	**Total Housing Units**
Bristol WPCF	Bristol	10.75/9.0 mgd	Pequabuck River	Approx. 16,000	24,886	26,125
Plainville WPCF	Plainville	3.0/2.0 mgd	Pequabuck River	Approx. 5,600	7,385	7,707
Plymouth WPCF	Plymouth	1.75/NA mgd	Pequabuck River	Approx. 3,020	4,453	4,646

*--Sewage data obtained from Public Works dept. of respective towns.

Map 7. Pequabuck River Watershed

Public Sewer Service Areas



Data Source:
Connecticut DEP
Environment & Geographic
Information Center, 2003;
Public Works Dept. of Town of
Bristol, Burlington, Farmington
Plainville & Plymouth.

Prepared By: CCRPA
225 N. Main St., Ste. 304
Bristol CT 06010
ccrpa@ccrpa.org www.ccrpa.org

Land Use

Land use and zoning regulations generally determine the distribution of land and type of development within a town, such as residential, commercial/industrial, and open space. Land use and zoning are important as they regulate the use of land to minimize traffic congestion, pollution, and improve quality of life.

Land use patterns of a town have a direct impact on a watershed. The type and pattern of land use is greatly responsible for the amount of non-point source pollution of the waterbodies within a watershed. Agricultural and residential land may cause pesticides and fertilizers to pollute streams and waterbodies, whereas impervious surfaces, like parking lots and roads, may increase runoff and the amounts of hydrocarbons and other automotive residues to contaminate the waterbodies in the area. In this context, land use planning is very important in order to protect, maintain and improve the health of water bodies and the entire watershed within a region. Local Plans of Conservation & Development, zoning regulations, subdivision ordinances, aquifer protection programs, and inland/wetland regulations, are some of the regulatory and advisory components of a municipality that help determine the type and density of development that can occur within a watershed region. A difficulty that may arise with these regulations is that a watershed may exist within the boundary of several towns and each town may have different regulations regarding land use.

The Pequabuck River Watershed lies within the boundary of seven towns and two counties. These seven towns are under jurisdictions of three different regional planning agencies (Table 12). Although various towns and other jurisdictional boundaries define the watershed, one important thing to remember is that the health of the watershed is a

common concern for everyone. The actions of one town can affect the whole watershed, and therefore it is pertinent that all watershed towns work cooperatively in order to maintain and improve the health of their common watershed.

Table 12. Jurisdictions of Regional Planning Organizations

Town	Total Town Acreage	Percent within Watershed	Regional Planning Organization	County
Bristol	16960	85.30%	Central	Hartford
Burlington	19072	42.76%	Central	Hartford
Farmington	17952	25.86%	Capitol	Hartford
Harwinton	19680	14.87%	Litchfield	Litchfield
Plainville	6208	38.05%	Central	Hartford
Plymouth	13888	31.34%	Central	Litchfield
Wolcott	13075	0.53%	Central Naugatuck	New Haven

As mentioned earlier, land use regulations can help maintain and improve the health of the watershed. They also demonstrate the town's perception of development of land and conservation of natural resources. Towns are required, by state statutes, to show the most desirable use of land within the municipality for residential, recreational, commercial, industrial, conservation and other purposes in their Plans of Conservation & Development (Section 8-23, Connecticut General Statutes). Towns are also required to update their plan of conservation & development every ten years to accommodate any change in state statutes as well as to review growth in their own towns. There are various commissions in all seven watershed towns such as planning & zoning commission, conservation commission, inland wetlands& watercourses commission, zoning board of appeal, and board of public works to make sure that development is in compliance with the town's land use regulations as well as the Plan of Conservation & Development.

Table 13 below shows the year in which different land use regulations and Plans of Conservation & Development were adopted by the watershed towns in the Pequabuck River Watershed.

Table 13. Municipal Regulations*

Town	Plan of Conservation & Development	Zoning Regulations	Wetlands & Watercourses*	Floodplain Management*	Subdivision Regulations
Bristol	2000	1993	1973; 1990	See Zoning Regulations	1996
Burlington	1997	2002	1990	2002	1981
Farmington	1995	1996	1973;1996	See Zoning Regulations	1996
Harwinton	1995	1955;2000	1974	1982	1972;1982
Plainville	1997	1999	1999	1999	1953
Plymouth	1993	1961;1997	1974;1997	See Zoning Regulations	1988
Wolcott	1999	1999	2003	See Zoning Regulations	1999

*-- Further details in following pages.

As the table shows, towns in the watershed have adopted various land use regulations at different times to maintain and regulate growth in the towns and to protect the natural environment in their towns. The City of Bristol, for example, in its Plan of Conservation & Development, adopted in November 2000, recommends to “improve public awareness of the Pequabuck River as an open space and recreational asset”, and recommends to increase public access to the Pequabuck River (Bristol POCD, 2000). Similarly, the Town of Plymouth’s Plan of Conservation & Development recognizes the Pequabuck and Poland rivers as an important part of natural resources, and recommends assessment of development impacts on water quality, water supply, and flooding problems. The Town of Burlington, in its Plan of Conservation & Development, recommends review of the permitted uses in the zoning regulations to ensure surface

water as well as groundwater quality, and also to protect public water supply watershed areas. The Town of Plainville, too, recommends developing priorities for open space preservation that recognizes the importance of the Pequabuck River floodplain. Many of these recommendations can be seen integrated in land use regulations such as setback requirements in inland wetlands & watercourses regulations, open space and drainage requirements in subdivision regulations, and so on.

Table 14 and Map 8 below depict general land use-land cover patterns in the watershed area. Forest and open space are the most common land use in the Pequabuck River Watershed. More than 70% of the total watershed land is covered by forest and open space (CT DEP 2003). Residential and commercial development covers around 20% of the land. In terms of having the greatest proportion of land area in the watershed, Bristol encompasses 39% of the watershed and also has the most direct effect on the quality/quantity of water. Since the river passes through downtown Bristol, most of the runoff from downtown enters the river quickly carrying pollutants from the downtown area as well as nearby areas.

The population growth trends in the Watershed show an 11% increase between 2000 and 2020, which will require more housing and other urban infrastructure such as water supply and sewer lines (CT DOT 2002). Housing development may contribute to increased imperviousness and thus increase runoff to waterbodies. Similarly, the demand for more water as well as an increased amount of sewer and household disposal, and potentially higher chemical and fertilizer applications to lawns, puts more pressure on the watershed.

Map 8. Pequabuck River Watershed

Generalized Land Cover

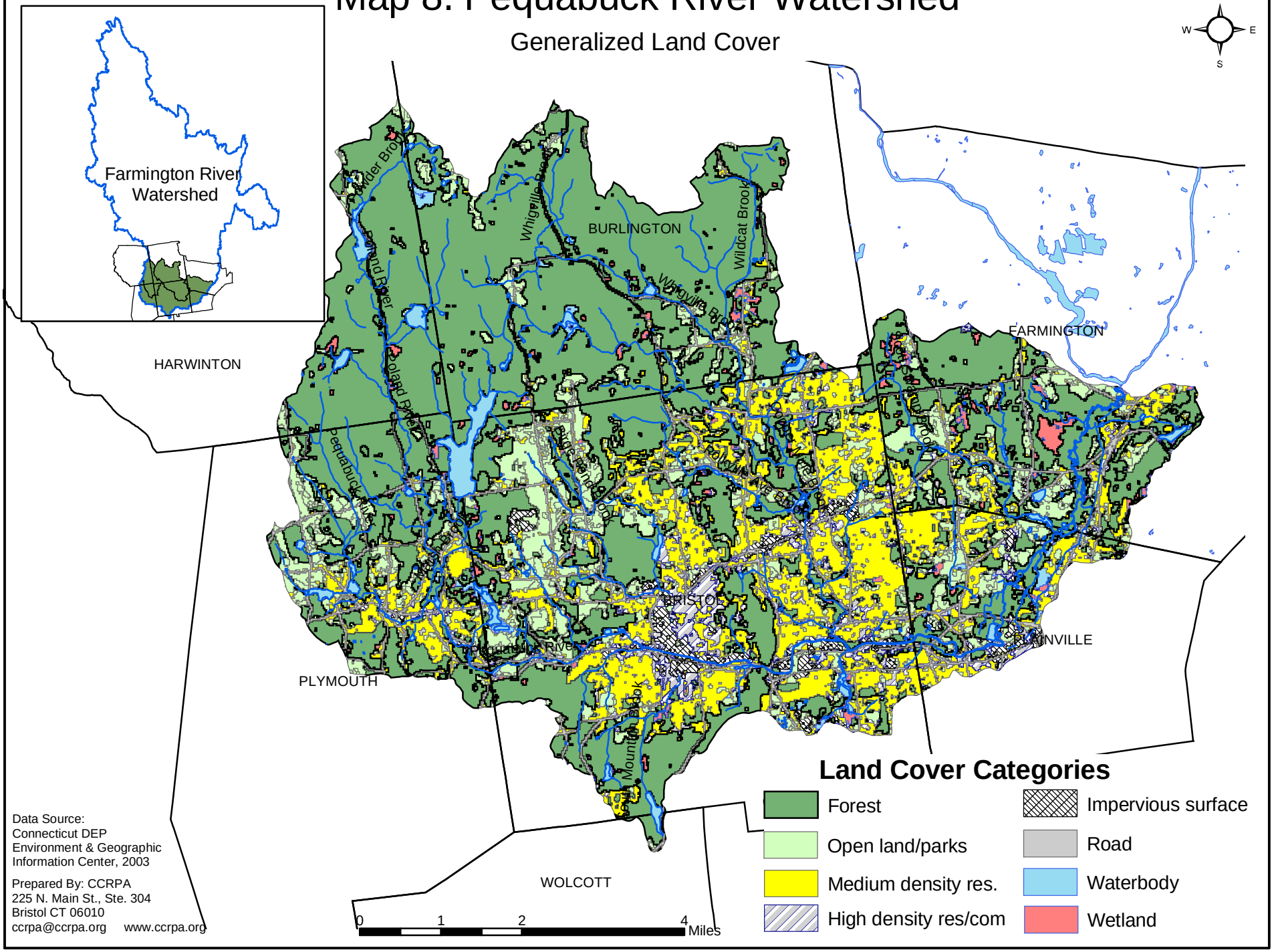


Table 14. Land Cover in the Pequabuck River Watershed

Land Use Categories	Acres	Sq. miles	Percentage
Coniferous Forest	473.485	0.74	1.28%
Cropland with Exposed Soil	34.425	0.054	0.09%
Deciduous Forest	19899.74	31.093	53.93%
Deep Water	415.048	0.649	1.12%
Open Land	790.08	1.235	2.14%
Exposed Soil	736.844	1.151	2.00%
Forested Wetlands	671.436	1.049	1.82%
High Density Res./Commercial*	**1365.626**	**2.134**	**3.70%**
Impervious Surface*	**796.867**	**1.245**	**2.16%**
Medium Density Res.*	**5537.737**	**8.653**	**15.01%**
Non-forested Wetland	17.569	0.027	0.05%
Pasture & Hay with Exposed Soil	1387.597	2.168	3.76%
Pasture and Grass	1773.941	2.772	4.81%
Pasture with Cropland	13.567	0.021	0.04%
Road*	**1722.386**	**2.691**	**4.67%**
Shallow Water	439.603	0.687	1.19%
Turf and Grass	822.04	1.284	2.23%
Total	**36897.991**	**57.653**	**100%**

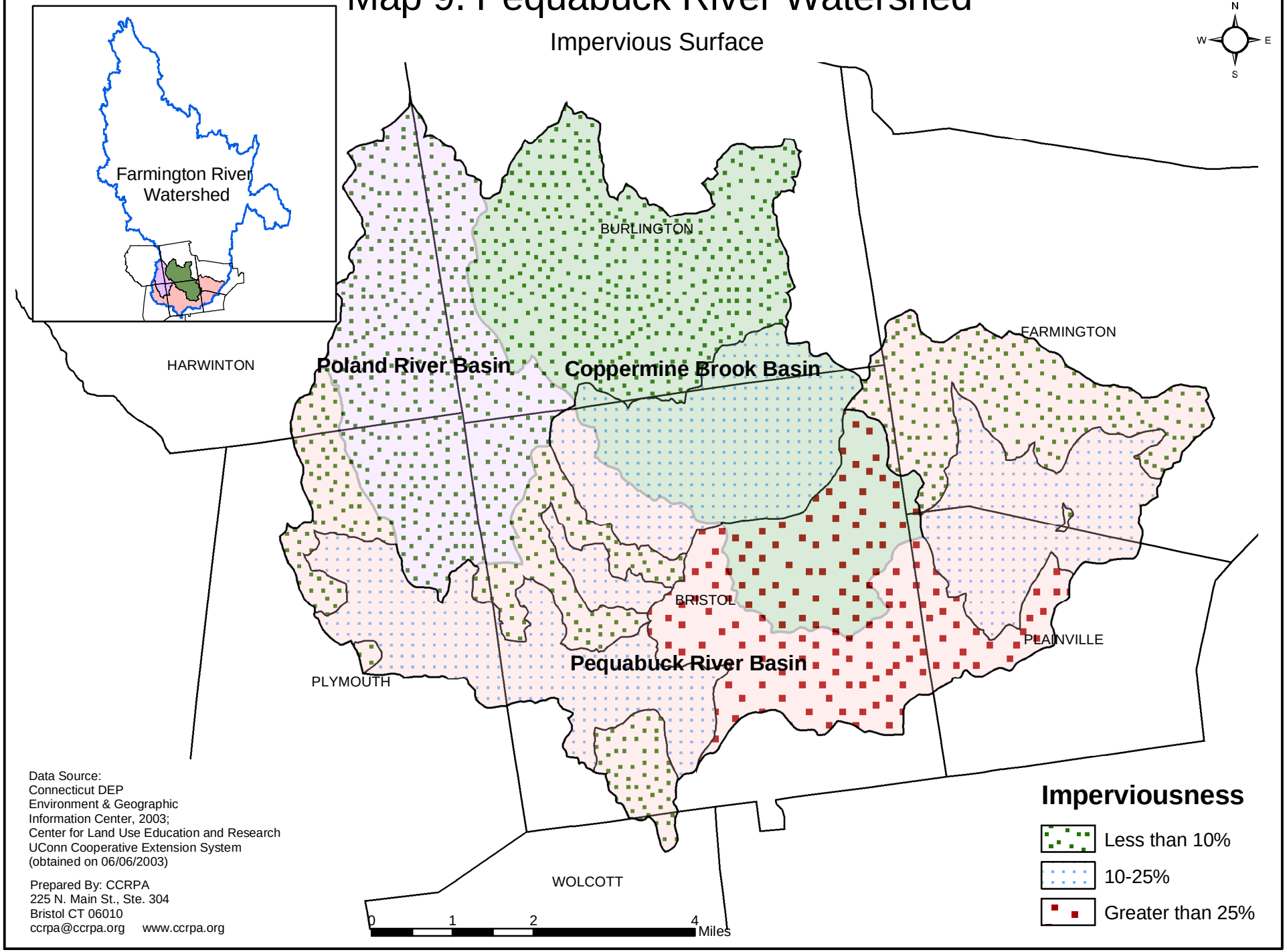
Data Source: CT DEP Environment and Geographic Information Center 2003.

--Constitute major impervious surface area

The above table shows different landcover, and the area of impervious surface in the watershed. Impervious surfaces are: roadways, parking lots, rooftops, sidewalks, and other areas covered by impenetrable materials such as asphalt, concrete, brick, and stone. These materials seal surfaces, and thus prevent water from infiltrating the soil. Instead of being absorbed by the ground, precipitation runs off into storm drains and is discharged directly into streams and other waterbodies, taking pollutants and other contaminants with it. In a fully developed urban setting, no rainwater is absorbed by the ground, while 95% becomes stormwater runoff (Clean Water Initiative 2000).

Map 9. Pequabuck River Watershed

Impervious Surface

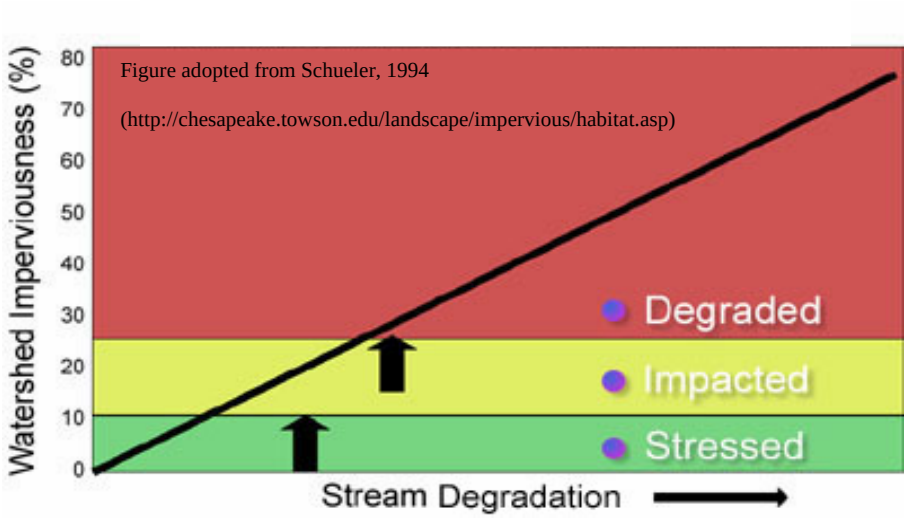


Data Source:
Connecticut DEP
Environment & Geographic
Information Center, 2003;
Center for Land Use Education and Research
UConn Cooperative Extension System
(obtained on 06/06/2003)

Prepared By: CCRPA
225 N. Main St., Ste. 304
Bristol CT 06010
ccrpa@ccrpa.org www.ccrpa.org

Impervious surfaces in a watershed adversely impact the health of the watershed. These effects include adverse impacts on water quantity, degraded water quality, changes to habitat, diminished stream and landscape aesthetics, bank erosion and flash floods. Similarly, impervious surfaces dramatically increase peak discharges during storm or snowmelt events, resulting in the increased flow and possible downstream flooding. According to different studies, biological integrity and habitat quality of streams are inversely affected by the amounts of impervious surfaces adjacent to them (Arnold & Gibbons1996; Klein1979; Schueler1994). A watershed is considered to be impacted when the impervious surface exceeds 10% of the total watershed (Schueler 1994).

Chart 9. Watershed Imperviousness and Stream Degradation



The above map (Map 9) which is developed based on the impervious surface analysis estimation, shows that approximately 17% of the watershed has more than 25% of impervious surface and about 31% of the watershed has between 10-25% of impervious surface. This trend is on the rise as more land is being developed for residential or other purposes. According to the above data and the chart (Chart 9) above, this level of imperviousness has an adverse impact on the health of the watershed. Although

immediate remedy is difficult, careful planning and management of developed areas can minimize existing impacts. Different towns in the watershed have implemented provisions in their zoning and subdivision regulations to reduce impacts from developed areas. Although not listed by specific names, proper drainage system and detention basins, cleaning of catch basins, are some of the regulations and provisions required by the towns. Detailed provisions on how to reduce impacts from developed areas on nearby waterbodies will be discussed in the forthcoming management plan.

Open Space

As human population increases, more land is needed to fulfill the demand for housing, recreation, and other facilities resulting in the decrease in available natural land needed for the maintenance and protection of wildlife and water quality and quantity. In order to facilitate development and protect the environment at the same time, a balanced approach is imperative. One way for municipalities to achieve this goal is to dedicate some portion of their land as open space and protect it from development and/or create buffer zones. Such land may be partially developed for recreational use or left in its natural state. This will help protect land from human encroachment and other development activities, and preserve the land in its natural state. Open space mainly includes conserved natural areas and some lightly developed areas such as recreational parks and playgrounds.

The land use distribution in the Pequabuck River Watershed shows that more than 70% of the total watershed area is undeveloped in the form of farmlands, forests, and wetlands. Much of this land cannot be considered open space since it could be privately owned and could be developed in the near future. Protected open space may either be owned by the federal government, state, municipalities, or private organizations such as land trusts, water companies, and game clubs. Various types of open space exist in the Pequabuck River Watershed. The following map (Map 10) and the table (Table 15) show the dedicated and managed open space in the watershed area.

Table 15. Open Space in the Pequabuck River Watershed	
Dedicated Open Space	**Area in Acres**
State Owned	474.07
Municipal Open Space	426.28
Private Land Trusts	349.20
Total Dedicated Open Space[3]	**1,249.55**
Managed Open Space	
Municipal Parks	330.25
Private Game Clubs	274.64
Water Company Land	4594.84
Total Managed Open Space[4]	**5,199.73**
Grand Total Open Space Area	**6,449.28**

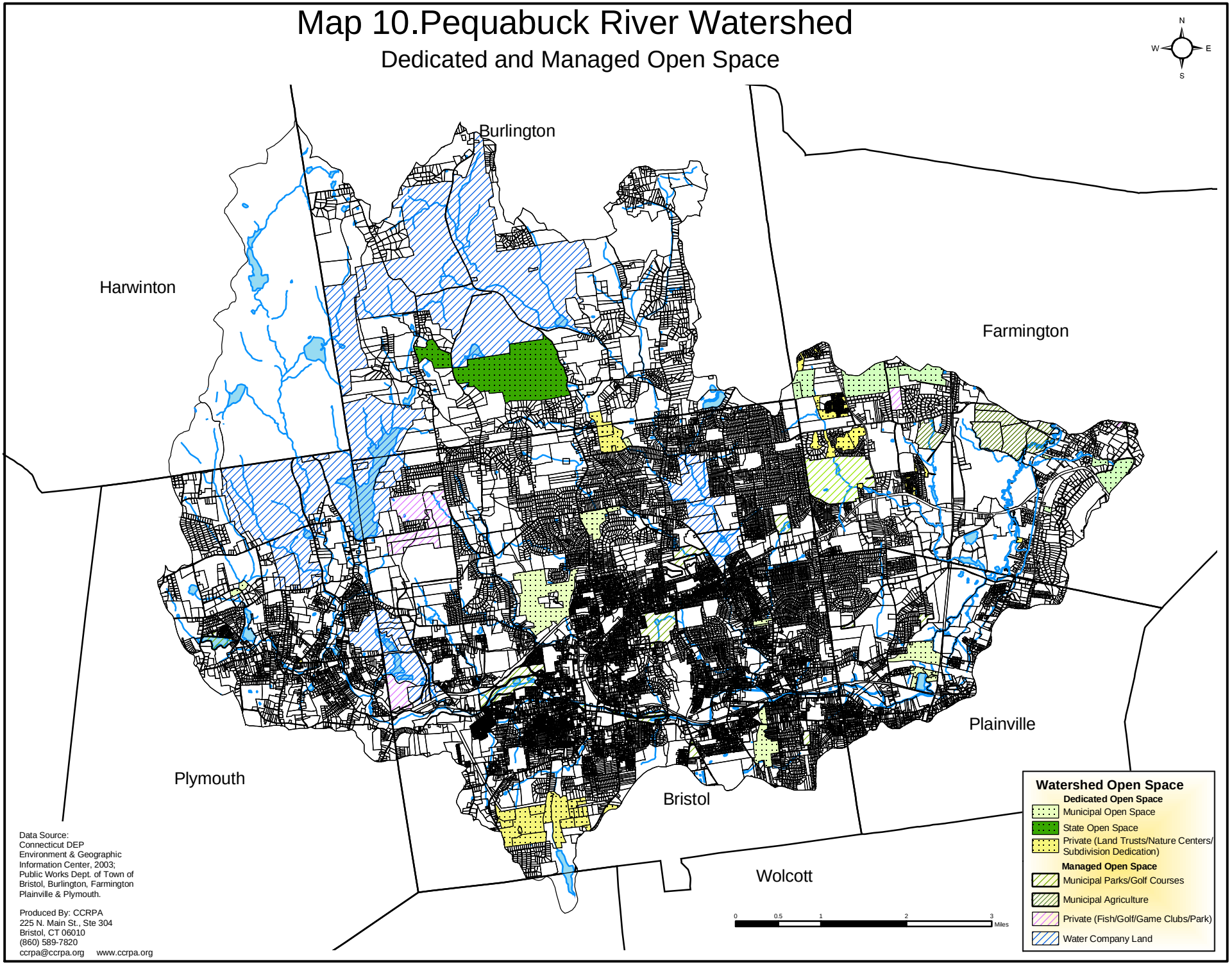
Open space can be developed either by donation, mandatory dedication, or purchase of land either by the town, conservation or land trusts or other private and/or public agencies. Towns also require some land to be dedicated as open space when new subdivisions are developed. The subdivision regulations of all seven towns in the watershed allow their Planning Commissions to require, as part of a new subdivision, the setting aside of up to 15 percent of the subject property as open space. Similarly, the Inland Wetlands Commissions occasionally require the establishment of conservation easements in connection with wetlands permit applications for new development.

[3] Dedicated open space is the land set aside with conservation as the primary reason and where no future developments are planned and would be left undeveloped.

[4] Managed open space is the land that has conservation as a secondary or subordinate reason (parks, for example, have recreation as the primary reason for establishment and conservation is secondary).

Map 10.Pequabuck River Watershed

Dedicated and Managed Open Space



Data Source:
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Produced By: CCRPA
225 N. Main St., Ste 304
Bristol, CT 06010
(860) 589-7820
ccrpa@ccrpa.org www.ccrpa.org

Inland Wetlands and Watercourses Regulations

The main function of inland wetlands and watercourses statutes is to preserve, protect and maintain the use of wetlands and watercourses by minimizing their disturbance and pollution which may adversely impact water quality, the environment, and ecology of the state (CT General Statutes Sec. 22a-36). Inland wetlands and watercourses regulations apply to certain activities which may affect a wetlands and/or watercourse. Besides those regulated activities occurring within an inland wetland or watercourse, the town commission may include a specified distance within which a permit review is required for certain activities that may require a permit. This regulated area from a watercourse or wetland can vary among towns as illustrated in Table 16 below. It is, however, noteworthy to mention that maintaining a vegetated buffer between developments and wetlands or watercourses as a Best Management Practice (BMP) is important for maintaining the aesthetics as well as the functional values of the waterbody and/or wetlands.

Table 16. Inland Wetlands and Watercourse Regulations

Town	Inland Wetlands and Watercourses Upland Review Area
Bristol	Within 100 feet requires permit; 200 feet from the boundaries of Cedar Lake, Pine Lake and Birge Pond requires permit
Burlington	Within 650 feet requires permit
Farmington	Within 25 feet requires permit
Harwinton	Within 100 feet requires permit
Plainville	Within 50 feet requires permit
Plymouth	Within 50 feet requires permit
Wolcott	Within 100 feet required permit

Stormwater Management and Soil Erosion and Sediment Control Regulations

Stormwater management regulations are generally used to regulate the amount of stormwater runoff that is produced from any new developments. New developments such as subdivisions, buildings, parking lots, or roads can significantly change the hydrology of the area. As a result, the volume and velocity of runoff can increase causing bank erosion and sedimentation of nearby streams. In this situation, regulations that manage stormwater and control its discharge into waterbodies will not only help reduce soil sedimentation and erosion but may also protect lives and property from damage caused by flash flood situations.

Another regulation that the towns' planning and zoning commissions use to prevent erosion and sedimentation of a watercourse is the Erosion and Sedimentation (E&S) Control Regulation. When developing land for multi-family residential, commercial or industrial and other uses, a soil erosion and sedimentation plan is required. If proper soil erosion and sediment controls are not properly installed and maintained, the development may cause excessive erosion and sedimentation of the nearby wetlands and stream causing flooding and other problems. Therefore, by towns requiring that developers submit a proper soil erosion and sediment control plan as part of their site plan application, and designing a stormwater management plan to control and treat runoff, development impacts can be reduced.

In addition to the towns' individual efforts to control stormwater, and soil erosion problems, the CT DEP has issued The General Permit for the discharge of stormwater from small municipal separate storm sewer systems (effective April 18, 2004) to implement EPA's Storm Water Phase II Program requirements. The purpose of the

permit is to improve water quality by reducing storm water non-point source pollution from small municipal separate storm sewer systems and small construction sites in urbanized areas. Bristol, Farmington and Plainville have urbanized areas as identified by the US Census and will be responsible to meet the obligations of this permit program. The permit requires the creation of a Storm Water Management Plan that incorporates a number of components to better protect local water quality and include the local community in the process.

A Storm Water Management Plan requires the following six minimum control measures be addressed:

1. Public education and outreach on storm water impacts required throughout the entire municipality;
2. Public involvement/participation required throughout the entire municipality;
3. Illicit discharge detection and elimination required throughout the entire municipality including mapping all storm water discharges from a pipe or conduit with a diameter of 15 inches or greater (or equivalent cross-sectional area) owned or operated by the municipality;
4. Construction site storm water runoff control required throughout the entire municipality;
5. Post-construction storm water management in new development and redevelopment; and
6. Pollution prevention/good housekeeping for municipal operations.

For each of these measures, municipalities are responsible for defining appropriate Best Management Practices (BMPs), designate a person(s) and job title responsible for each BMP; define a time line for implementation of each BMP, and define measurable goals for each BMP. In addition to the Storm Water Management Plan, monitoring of six

storm water outfalls during a wet weather event is required. At least two outfalls apiece shall be monitored from areas of primarily industrial development, commercial development and residential development, selected based on an evaluation by the municipality that the drainage area of such outfall is representative of the overall nature of its respective land use type.

Habitat

The Pequabuck River Watershed is rich with various natural habitats supportive of fish and wildlife. Various waterbodies and nearby lands in the Pequabuck River Watershed provide habitat to mammals, reptiles, and migratory and resident birds, including waterfowl and upland birds. The variety of habitats include lakes, shallow water, deep water, wetlands, marshes and wooded areas, shores of hardwoods, mixed conifers and shrubs. Nassahegan State Forest in Burlington, Marsh Pond in Bristol/Plymouth/Burlington, Shade Swamp Sanctuary in Farmington, Session Woods Wildlife Area in Burlington, Indian Rock Nature Preserve and Barnes Nature Center in Bristol, and the extensive wetlands in Plainville along the Northwest Drive area, are some examples of these habitats. Located near the confluence of the Pequabuck and Farmington rivers, Shade Swamp Wildlife Sanctuary is a wildlife refuge of about 800 acres owned by the State of Connecticut and managed with assistance from the Farmington Garden Club by the Wildlife Division of the CT DEP. It provides refuge to more than 100 different species of plants and animals (Emery 1972). Similarly, the Indian Rock Nature Preserve in Bristol, and Barnes Nature Center in Bristol and Wolcott also provide habitats for various species of plants and animals.

Fish

The Pequabuck River and its tributaries provide habitat for several species of freshwater and migratory fish. The following list provides few species of fish in the Pequabuck River and its tributaries (Hagstrom et. al. 1989):

- American eel
- brown bullhead
- bluegill sunfish
- brook trout
- blacknose dace
- brown trout
- creek chub
- common shiner
- fallfish
- fathead minnow
- grass pickerel
- golden shiner
- banded killifish
- longnose dace
- largemouth bass
- pumpkinseed
- tesselated darter
- white sucker
- yellow perch

Atlantic salmon and trout are some of the species of fish that are stocked in the Pequabuck River and its tributaries every year. Under CT DEP's Atlantic salmon management program, since 1994 the Pequabuck River has been stocked annually with approximately 18,000 Atlantic salmon fry. The section that is stocked extends upstream from the Route 229 bridge in Bristol to the Plymouth town line. Survival for these fish during the first year averages 30% with 12% being large enough (5"or larger) to migrate to sea as smolt the following spring. Approximately 4% of the fish stocked as fry will stay or survive in the river until the end of the second year. The total number of salmon smolts produced each year is approximately 800.

The year 2002 was the first year of catch-and-release within the Pequabuck River/Coppermine Brook Trout Management Area[5] (TMA). The TMA was stocked with

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[5] Trout Management Areas feature area-specific regulations such as fly-fishing and catch-and-release only. These areas may also combine other Trout Management Program categories. For example, the area from routes 229 and 72 in Bristol to Route 117 in Plainville is open year round under catch-and-release-only regulations.

1,440 adult trout (mostly brown trout) early in the spring of 2002, because trout population samples in fall 2001 had indicated low trout densities (59/mile). This was probably due to low flows and high water temperatures experienced during 2001. The 2002 trout electrofishing catch rate in the Pequabuck River TMA of 101 fish/mile of stream is slightly lower than the density found during pre-catch and release sampling when the area was not stocked (average 118 fish/mile of stream). It is likely that this low density was due to extreme low flows, high water temperatures and/or non-compliance with the new fishing regulations. The water temperatures in 2002 were the worst (warmest) measured in local streams during the last 5 years. Although the actual data is not yet available, in the year, 2003, better survival was expected as the summer had been cooler in temperature.

Birds

A number of birds that can be found in the Pequabuck River Watershed include (DeGraff & Yamasaki 2001; Rosen & Billings 1996; Bevier 1994):

Waterfowl:

Resident: common merganser, Canada goose

Winter: bufflehead

Breeding: wood duck, hooded merganser, mute swans (ecologically damaging exotic species), mallard (probable resident), American black duck (possible resident), pied-billed grebe (population declining)

Migrant: ring-necked duck, common goldeneye, common loon (species of special concern)

Shorebirds:

Winter: great blue heron

Breeding: spotted sandpiper, green-backed heron

Migrant: common snipe (rare winter resident), least sandpipers, solitary sandpiper, greater and lesser yellowlegs, great egret (possible breeder)

Upland Birds:

Resident: dark-eyed junco, northern cardinal, eastern meadowlark (requires declining grassland habitat)

Winter: northern shrike

Breeding: various vireo's (including white-eyed vireo, yellow-throated, blue-headed vireo), black-throated green warbler, cerulean warbler, yellow-bellied sapsucker

Migrant: black-throated blue warbler (probable breeder)

Listed Species

The Natural Diversity Data Base (NDDB) established in 1983, and maintained by the CT DEP, has information on the status of different state Endangered, Threatened, or Species of Special Concern[6] of plants, wildlife, and natural communities in the state of Connecticut. More than 10 different areas of concern have been identified in the Pequabuck River Watershed. Information collected on more than 1,000 species of flora

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[6] *"Endangered Species"* means any native species documented by biological research and inventory to be in danger of extirpation throughout all or a significant portion of its range within the state and to have no more than five occurrences in the state, and any species determined to be an "endangered species" pursuant to the federal Endangered Species Act.

"Threatened Species" means any native species documented by biological research and inventory to be likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range within the state and to have no more than nine occurrences in the state, and any species determined to be a "threatened species" pursuant to the federal Endangered Species Act, except for such species determined to be endangered by the Commissioner in accordance with section 4 of this act.

"Species of Special Concern" means any native plant species or any native non-harvested wildlife species documented by scientific research and inventory to have a naturally restricted range or habitat in the state, to be at a low population level, to be in such high demand by man that its unregulated taking would be detrimental to the conservation of its population or has been extirpated from the state.

and fauna, including invertebrates, and 45 significant natural communities[7] from biologic inventories of the state's species and habitats, conducted over the past ninety years by the Connecticut Geological and Natural History Survey, has been incorporated into the Natural Diversity Data Base (http://www.dep.state.ct.us/cgnhs/nddb/nddb2.htm). According to NDDB, the Watershed contains six state-listed species and one significant natural community. According to a study done by the Bristol Regional Environmental Center in the Bristol area and its vicinity in the late 1970s, the Pequabuck River Watershed provides habitat to at least three species of special concern mammals: the silver-haired bat, the Hoary bat, and the southern bog lemming. The Indiana bat, which is listed as a federally endangered species, also resides in the area, according to the report. Reptiles such as the wood turtle, the eastern ribbon snake, and the eastern hognose snake, listed as Species of Special Concern, also reside in the watershed area. Similarly, the report lists eight different species of birds that are either listed as state endangered, threatened, or species of special concern in the area. Some of these species are the bald eagle, the sharp-shinned hawk, the red-shouldered hawk, the American kestrel, and the brown thrasher. Similarly, according to a bird watch survey done in 1996-1997, threatened bird such as the cooper's hawk was sighted in the area.

Invasive Species

There are a number of 'invasive' bird species in the Watershed; two specifically are the mute swan and the Canada goose. The mute swans are considered to be an

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[7] Significant Natural Communities is the representative of common as well as rare, and uncommon vegetation (plant) communities.

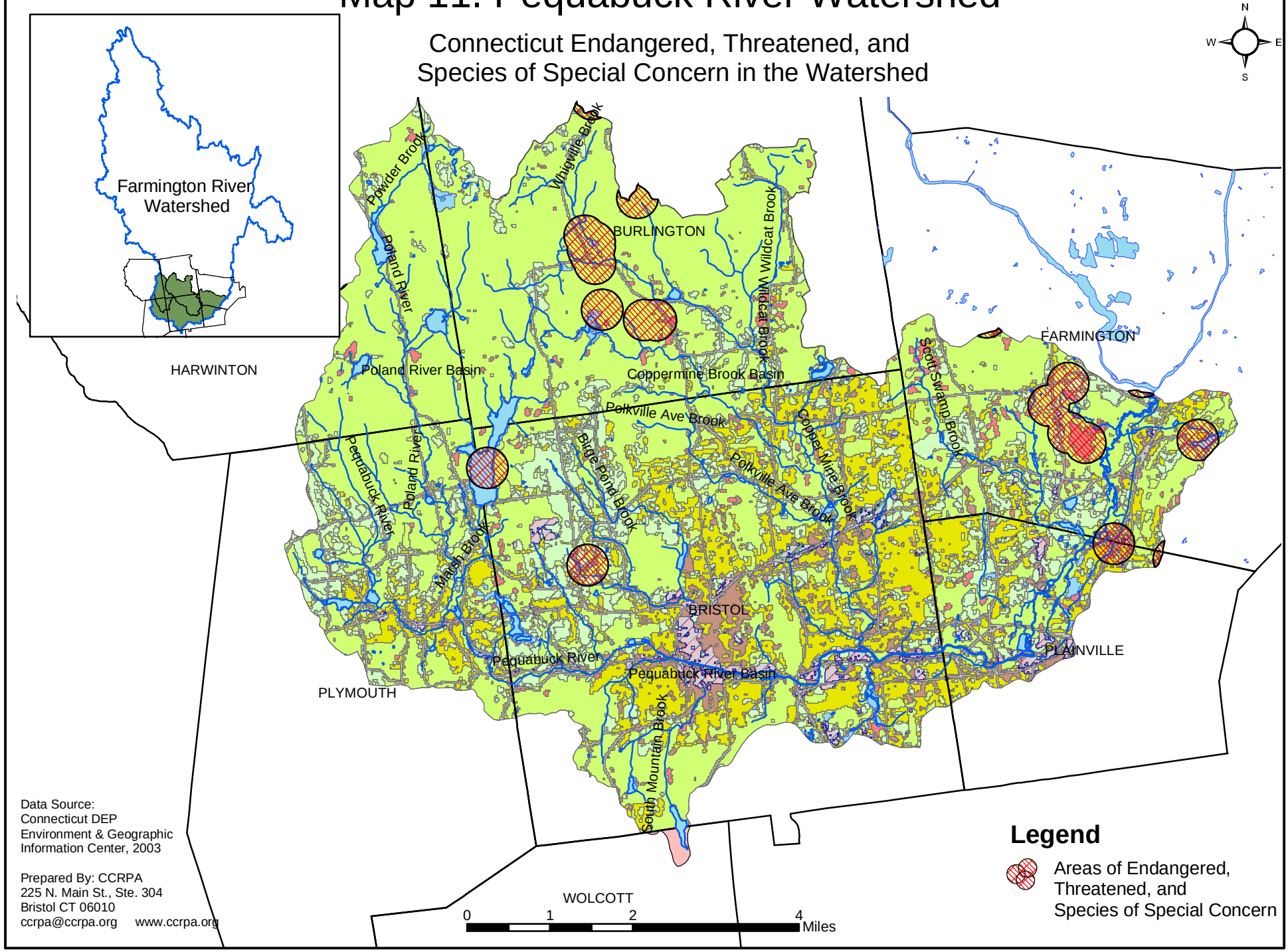
ecologically damaging exotic species (CT DEP 1999). The aggressive behavior of mute swans towards native waterfowl cause them to avoid nesting in the areas where mute swans reside. They, similarly, graze heavily and uproot aquatic vegetation important as a food source for native waterfowl. In addition to mute swans, increasing numbers of resident Canada geese are becoming another concern in the area. Because of hunting restrictions and the favorable conditions for these geese such as manicured lawns and feeding by people, many of them are now staying through the winter season instead of migrating each fall, which has become a problem to many areas (golf courses, swimming areas and private property along waterways).

The number of threatened, endangered, and species of special concern as well as other animals, reptiles, and birds is declining because of habitat destruction and other environmental problems. Similarly, various structures built along the river, such as the old mill dam that created Horseshoe Falls in Plymouth; culvert construction and channel diversions in downtown Bristol; have significantly altered its natural flow and affected ecosystems such as movement of fish.

The map below (Map 11) shows the state and federal listed species and significant natural community areas in the Pequabuck River Watershed. The map provides a general location of the species but does not provide specific details of each site for its own protection and to avoid problems associated with harassment and collection of the species or destruction of the habitat.

Map 11. Pequabuck River Watershed

Connecticut Endangered, Threatened, and Species of Special Concern in the Watershed



Data Source:
Connecticut DEP
Environment & Geographic Information Center, 2003

Prepared By: CCRPA
225 N. Main St., Ste. 304
Bristol CT 06010
ccrpa@ccrpa.org www.ccrpa.org

Macroinvertebrates

The composition and the characteristics of the macroinvertebrate community can be a useful tool for detecting water quality and environmental impacts of pollutants as well as non-point sources in a waterbody. The CT DEP, Bureau of Water Management's, Ambient Monitoring Program has designed a volunteer program to collect macroinvertebrate community data from streams in Connecticut (http://www.dep.state.ct.us/wtr/volunmon/2000rbvsummary.pdf). The program called Rapid Bioassessment in Wadeable Streams and Rivers by Volunteer Monitors (RBV), collect macroinvertebrate data to determine the water quality and aquatic environment of the streams. The RBV volunteers surveyed and collected data from four different locations in the Pequabuck River in 1999 and 2000.

The survey data showed that the Pequabuck River lacks the organism community that can thrive only in good quality water, in all four locations. The macroinvertebrate community was found to be dominated by pollution tolerant organisms. The RBV has divided macroinvertebrate community into one of the three "wanted" categories; Most, Moderate, or Least. The "most wanted" organisms require high quality environmental conditions, and are indicators of very good water quality. The "moderately wanted" organisms can be found in a variety of environmental conditions from high to medium water quality. The "least wanted" organisms are able to tolerate a wide range of environmental impacts and their wide presence can infer water quality impairment. Organisms such as stonefly, and michelin-man caddisfly, which can survive only in good water quality environment, were rarely seen in the Pequabuck River. Similarly, other most wanted organisms such as body builder mayfly, and minnow mayfly were not

sighted in the Pequabuck River. Organisms such as snail, midge, black fly, which are on least wanted list, were frequently sighted in the river. Few moderately wanted organisms such as common net spinner, flat-headed mayfly, and fishfly larva, were also seen during the survey. The following table (Table 17) shows the results of RBV findings:

Table 17. Rapid Bioassessment Result

Site Number	Location	Town	Most Wanted	Moderately Wanted	Least Wanted
Year 1999					
8-001	Canal St.	Plymouth	1	3	2
8-002	Rockwell Park	Bristol	0	2	2
8-003	USGS Gauge	Bristol	0	2	4
8-004	East Main St.	Plainville	0	3	5
Year 2000					
8-002	Rockwell Park	Bristol	1	4	2
8-004	East Main St.	Plainville	1	3	1

(Source: CT DEP)

In essence, the Pequabuck River seems to lack diversity in macroinvertebrate organisms. One of the reasons for this situation could be that the water quality of the river is not good enough to support these organisms. External factors such as time, locations, and quality of survey might have affected the result. Last but not least, a detailed bioassessment would be very helpful to understand the current situation of the Pequabuck River and factors behind it.

Conclusion

The state of one of Connecticut's important watershed regions, the Pequabuck River Watershed, has been presented in this report. The State of the Watershed Report has been prepared based on research of water quality and flow information, watershed history, along with other watershed related issues such as land use practices and regulations, and habitat of the region.

Research shows that the Pequabuck River has been one of the most polluted rivers in Connecticut since the beginning of the 20th century. The CT DEP has listed (Section 303(d) reporting) many segments within the Pequabuck River Watershed as impaired waterbodies due to high turbidity, high levels of bacteria, habitat alteration, and unknown stressors in the water.

Historically the main reason for water quality degradation was the discharge of large quantities of poorly treated municipal sewage and industrial waste from different industries in the early 1800's and, later, the discharges from the automotive, high-tech and recycling businesses of the 20th and 21st centuries. Various non-point sources also contribute to the contamination of already poor quality water. Moves to improve water quality in the Pequabuck River were made in the late 1970's as treatment procedures improved for both industrial discharge and wastewater treatment at municipal facilities. Similarly, watershed organizations also started monitoring programs to evaluate water quality and determine potential sources of pollution.

In the 1980s, as water quality improved, CT DEP Fisheries Division started to stock trout, and in 1994, Atlantic salmon fry in the Pequabuck River Watershed. There is now a catch and release Trout Management Area from Rockwell Park in Bristol to Route 177

in Plainville, including part of the Coppermine Brook. The Pequabuck River Watershed Association has supplemented the CT DEP trout stocking each fall since 1995.

Although the water quality has improved, many challenges remain ahead:

- The Watershed is still falls short of CT DEP water quality designated usage goals;
- Non-point source pollution is a major concern in the watershed. Wastewater and discharge regulations are limited mostly to point sources. Non-point sources (such as snow and rain), which are hard to detect, are polluting the river. The newly introduced Phase II Storm Water Management Program may be helpful to curb illicit discharges to the river and also control non-point source pollution to some extent;
- Population growth trends indicate a possible 11% increase between 2000 and 2010, which will only add to the problems mentioned above, as well as increase demands on the water supply. The water supply is already heavily taxed due to the following demands: drinking water, industrial uses, recreational uses, and waste water assimilation needs;
- Land use patterns have a direct impact on the quality of water. Towns in the Watershed have implemented various land use regulations to protect their watercourses and wetlands. Although these regulations have helped to protect the watercourses and wetlands from direct encroachment, they have not succeeded to protect the river from various non-point sources of pollution;
- Parts of the Watershed have high percentages of impervious surfaces, which pose a threat to water quality via non-point source pollution as well as negatively affecting water quantity. Approximately 17% of the watershed has more than 25%

of impervious surface and about 31% of the watershed has between 10-25% of impervious surface (Map 9). Having more than 25% of impervious surface indicates degraded water quality, and between 10-25% of impervious surface indicates impacted water quality (Schueler 1994);

- The Pequabuck River Watershed includes important habitat areas including Shade Swamp Sanctuary in Farmington, Indian Rock Nature Preserve and Barnes Nature Center in Bristol, and Sessions Woods Wildlife Management Area in Burlington. The Watershed provides habitat for many endangered species and species of special concerns such as the silver-haired bat, Hoary bat, Indiana bat, Cooper's hawk, and eastern ribbon snake, but the number of these animals, reptiles, and birds is declining because of habitat destruction and land development; and
- The Pequabuck River lacks macroinvertebrate diversity, which indicates low water quality.

The next step of this project will be to take the findings from this report and develop a Management Plan for the Pequabuck River Watershed. The Management Plan will include strategies on determining the causes of impairment as well as strategies to improve the problems identified in this report.

Glossary

Aesthetics: Characteristics of surface water such as appearance, and odor which may impact its uses.

Algae: One-or multi-celled, mostly aquatic plants that lack true stems, roots, and leaves, but usually contain chlorophyll. Algae convert carbon dioxide and inorganic nutrients such as nitrogen and phosphorus into organic matter through photosynthesis.

Alkalinity: Refers to the presents of bicarbonates, carbonates, and hydroxides that shift the pH below 7.

Anadromous: Migrating upstream to fresh water streams to spawn.

Aquifer: An underground layer of rock or soil containing groundwater.

Arithmetic Mean: The number, calculated by dividing the sum of all values by the number of values to be averaged.

Benthic Macroinvertebrates: Organisms and/or animals which can be seen by the unaided eye, and which live at least part of their life cycle within or upon submerged substrates in a body of water. These animals usually consist of the aquatic life stages of various insects and arthropods, mollusks, leeches and worms.

Best Management Practices (BMPs): Management practices such as nutrient management or structural practices such as vegetated drainage swales or buffers designed to reduce the quantities of pollutants such as sediment, nitrogen, phosphorus, and animal wastes in the waterbodies, such as lakes, creeks, streams, rivers, estuaries, and ground water.

Biochemical Oxygen Demand (BOD): The quantity of largely organic, materials present in a water sample as measured by a specific test.

Designated Use: Those uses specified in the CT Water Quality Standards for each surface water (or groundwater) classification, whether or not they are being attained.

Detention: The process of collecting and holding back stormwater for delayed release to receiving waters.

Discharge Permit: Legal contract negotiated between federal and state regulators and an industry or sewage treatment plant that sets limits on many water pollutants or polluting effects from the discharges of its pipes to public waterbodies.

Discharge: The volume of flow of solution.

Dissolved Oxygen: The amount of oxygen present in the water column. More than 5 parts oxygen per million (ppm) is considered healthy; below 3 is generally stressful to aquatic organisms.

Domestic Sewage: Wastewater which consists of water and human excretions or other waterborne wastes incidental to the occupancy of a residential building or a non-residential building.

Drainage Area: An area of land that drains to certain waterbody; watershed.

Effluent: Treated or untreated liquid waste material from a point source, such as a wastewater treatment plant or an industrial facility that is discharged into the waterbody or land.

Endangered Species: Any native species documented by biological research and inventory to be in danger of extirpation throughout all or a significant portion of its range within the state and to have no more than five occurrences in the state, and any species determined to be an "endangered species" pursuant to the federal Endangered Species Act.

Erosion: Wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical, chemical, or biological forces.

Eutrophic: Condition refers to a nutrient-enriched, highly productive waterbody.

Eutrophication: A process by which a waterbody becomes rich in dissolved nutrients, often leading to algal blooms, low dissolved oxygen, and changes in community composition. Eutrophication occurs naturally, but can be accelerated by human activities that increase nutrient inputs to the waterbody.

Fecal Coliform: Bacteria from the colons of warm-blooded animals which are released in fecal material. Specifically, this group comprises all of the aerobic and facultative anaerobic, and rod-shaped bacteria.

Geometric Mean: A measure of central tendency calculated by determining the anti-log of the mean of the logarithms of the values to be averaged.

Groundwater: The water that occurs beneath the earth's surface between saturated soil and rock and that supplies wells and springs.

Habitat: A specific area in which a particular type of plant or animal lives.

Hazardous Waste: Any solid, liquid, or gaseous substance which, because of its source or measurable characteristics, is classified under state or federal law as hazardous and is subject to special handling, shipping, storage, and disposal requirements.

High Quality Waters: Surface waters where the water quality is better than necessary to meet the criteria established in these Water Quality Standards for the applicable classification or which may sustain a sensitive use designated for a higher classification.

Hydrocarbons: Any of a vast family of compounds originating in materials containing carbon and hydrogen in various combinations. Some may be carcinogenic; others are active participants in photochemical processes in combination with oxides of nitrogen.

Impaired Water: Surface and ground waters that are negatively impacted by pollution, or physical alteration, or modification resulting in decreased water quality.

Impervious Surface: A surface such as pavement that cannot be easily infiltrated by water.

Indicator bacteria: A species or group of microbes which are used to conduct microbiological examinations of water in order to determine its sanitary quality. The primary function of these indicators is to provide evidence of recent fecal contamination

from warm blooded animals. They serve as surrogates for pathogens which may be present in sewage.

Land Use: Development and uses of land for various activities such as agriculture, residences, industries, etc. Certain types of pollution problems are often associated with particular land uses, such as sedimentation from construction activities and pesticides anf fertilizers from agriculture.

Level B aquifer protection area: Preliminary critical area around well fields in stratified drift used by water systems serving over 1000 people. The protected area encompasses the area of contribution and recharge area of the well field. This preliminary mapping will be refined by the water companies using extensive, site-specific data and ground water modeling to determine the final (or Level A) mapping area. The final mapping will define the regulatory boundaries for land use regulations. The Aquifer Protection Land Use Regulation applies only to regulated activities located within the Level A mapping boundary of a protected aquifer.

Macroinvertebrate: Invertebrates visible to the naked eye, such as snail and mayfly.

Natural Community: A distinct and reoccurring assemblage of populations of plants, and/or animals naturally associated with each other and their physical environment.

Nitrate: A form of nitrogen which is readily available to plants as a nutrient. Generally, nitrate is the primary inorganic form of nitrogen in aquatic systems.

Nitrogen: An element which in living organisms is a component of protein structures.

Nonpoint Source Pollution (NPS): Pollution originating from stormwater runoff from areas having no well-defined source such as land surfaces and roadways.

Nutrients: Chemicals that are needed by plants and animals for growth (e.g., nitrogen, phosphorus). In water resources, if other physical and chemical conditions are optimal, excessive amounts of nutrients can lead to degradation of water quality by promoting excessive growth, accumulation, and subsequent decay of plants, especially algae, creating eutrophic condition.

Pathogen: Organisms such as a virus, bacteria, or fungus that can cause diseases in humans.

Pesticides: Chemical materials that are used for the control of undesirable insects, diseases, vegetation, animals or other forms of life.

pH: A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The scale is 0-14. Technically it is the negative log of the hydrogen ion concentration (-log10 [H+]).

Phosphorus: An element essential to the growth and development of plants, but which, in excess, can be the limiting nutrient to problematic blue-green algal blooms.

Point Source: Any confined and discrete conveyance from which pollutants are or may be discharged. These include pipes, ditches, channels, tunnels, conduits, wells, containers, and concentrated animal feeding operations.

Pollutant: A contaminant that adversely alters the physical, chemical, or biological properties of the water and environment. The term includes nutrients, sediment, pathogens, toxic metals, carcinogens, oxygen-demanding materials, and all other harmful substances.

Recreational use: Active or passive water-related leisure activities such as fishing, swimming, boating, and aesthetic appreciation.

Riffle: Area of a stream or river characterized by a rocky substrate and turbulent, fast-moving, shallow water.

Runoff: Water that is not absorbed by soil and drains off the land into waterbodies.

Sanitary Survey: An investigation of a particular geographic area to determine if unlawful or inadequately treated discharges of sewage or other sources of indicator bacteria are present.

Saturated zone: Underground area of the earth where void spaces in the soil or rock are filled completely with water.

Sediment: Particles of sand, clay, silt, and plant or animal matter present in water.

Sewage: Defined in Sec. 22a-423 of the General Statutes and means "human and animal excretions and all domestic and such manufacturing wastes as may tend to be detrimental to the public health."

Significant Natural Communities: Plants representative of common as well as rare, and uncommon vegetation (plant) communities.

Species of Special Concern: Any native plant species or any native non-harvested wildlife species documented by scientific research and inventory to have a naturally restricted range or habitat in the state, to be at a low population level, to be in such high demand by man that its unregulated taking would be detrimental to the conservation of its population or has been extirpated from the state.

Stakeholders: Concerned individuals or groups such who live in the watershed or have land management responsibilities in it. It includes government agencies, businesses, private individuals and special interest groups.

Stormwater: Rainwater that runs off the land, usually paved or compacted surfaces in urban or suburban areas, and drained into nearby waterbodies.

Subbasins: One of several basins that form a watershed.

Suspended Solids: Organic and inorganic particles, such as solids from wastewater, sand, clay, and silt, that are suspended and carried in water.

Threatened Species: Any native species documented by biological research and inventory to be likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range within the state and to have no more than nine occurrences in the state, and any species determined to be a "threatened species" pursuant to the federal Endangered Species Act, except for such species determined to be endangered by the Commissioner in accordance with section 4 of this act.

Total Kjeldahl Nitrogen (TKN): An oxidative procedure that converts organic nitrogen forms to ammonia by digestion with an acid, catalyst, and heat. Total Kjeldahl nitrogen is a measure of the concentration of reduced forms of nitrogen in surface water, principally, ammonium and amino forms of organic nitrogen.

Total Suspended Solids (TSS): The measurement by weight of particles that are suspended in water. Suspended solids in water reduce light penetration in the water column, can clog the gills of fish and invertebrates. Suspended solids can result from erosion from urban runoff and agricultural land, industrial wastes, bank erosion, bottom feeders (such as carp), algae growth or wastewater discharges.

Turbidity: A measure of the amount of light intercepted by a given volume of water due to the presence of suspended and dissolved matter and microscopic organisms. Increasing the turbidity of the water decreases the amount of light that penetrates the water column. High levels of turbidity are harmful to aquatic life.

Urbanized Area: For Census 2000, the Census Bureau classifies as "urban" all territory, population, and housing units located within an urbanized area (UA) or an urban cluster (UC). It delineates UA and UC boundaries to encompass densely settled territory, which consists of core census block groups or blocks that have a population density of at least 1,000 people per square mile, and surrounding census blocks that have an overall density of at least 500 people per square mile. In addition, under certain conditions, less densely settled territory may be part of each UA or UC.

Water Quality: The physical, chemical and biological characteristics of surface or ground waters.

Water Quality Classification: The designation of the proposed uses of surface and ground waters with alphabetic characters. Where classifications appear as alphabetic characters separated by a diagonal line, the first classification indicates known or presumed existing water quality and the second classification indicates the goal for the subject water.

Water Quality Standards: Established limits of certain chemical, physical, and biological parameters in a water body; water quality standards are established for the different designated uses of a waterbody.

Water Table: The depth or level below which the area is saturated with water.

Watershed: The area of land from which rainfall (and/or snowmelt) drains into a certain waterbody such as lake, stream or a river. Watersheds are also sometimes referred to as drainage basins or drainage areas.

Wetlands: Defined in Sec. 22a-38(15) of the General Statutes and means Land, including submerged land, which consists of any of the soil types designated as poorly drained, very poorly drained, alluvial, and floodplain by the National Cooperative Soils Survey.

Zoning: Designating by ordinance areas of land reserved and regulated for different land uses.

Bibliography

Arnold, C. L., Jr. and C. J. Gibbons. 1996. Impervious Surface Coverage: The Emergence of a Key Environmental Indicator. Journal of the American Planning Association 62(2): 243-258.

Bell, Michael. 1985. The Face of Connecticut. People, Geology, and the Land. State Geological and National History Survey of Connecticut, Bulletin No. 10.

Central Connecticut Regional Planning Agency. 2000. The Pequabuck River Watershed Action Plan.

City of Bristol. 2002/03. Departments of Public Works, Planning, & Water Supply.

City of Bristol. 2003. Water Pollution Control Facility.

Connecticut Department of Environmental Protection, Wildlife Division.1999. Wildlife in Connecticut, Informational Series: Mute Swan.

Connecticut Department of Environmental Protection. 2002. 2002 Water Quality Report to Congress; Prepared Pursuant to Clean Water Act Section 305(b).

Connecticut Department of Environmental Protection, Bureau of Water Management, Ambient Monitoring Program. Rapid Bioassessment in Wadeable Streams and Rivers by Volunteer Monitors Year 2000 Summary Report. http://www.dep.state.ct.us/wtr/volunmon/2000rbvsummary.pdf.

Connecticut Department of Environmental Protection, Bureau of Water Management, Wetlands Management Section. 1997. Guidelines: Upland Review Area Regulations, Connecticut's Inland Wetlands & Watercourses Act.

Connecticut Department of Environmental Protection. 2002. Connecticut Consolidated Assessment & Listing Methodology for 305(b) and 303(d) Reporting.

Connecticut Department of Environmental Protection. 2002. 2002 List of Connecticut Waterbodies Not Meeting Water Quality Standards.

Connecticut Department of Environmental Protection. 1997.The Pequabuck River- 30 Years of Connecticut's Clean Water Facts.

Connecticut Department of Environmental Protection. 2002. Water Quality Standards.

Connecticut Department of Transportation (ConnDOT), Bureau of Planning. 2002. Office of Inventory & Forecasts.

Connecticut Economic Resource Center (CERC). 2002. Connecticut Town Profiles. http://www.cerc.com/detpages/resources373.html

Connecticut River Watch Program. 2002. Water Quality Sampling.

DeGraff, R. M. & Mariko Yamasaki.2001. New England Wildlife: Habitat, Natural History, and Distribution. University Press of New England. Hanover.

Earthscape. 2003. Hydrologic Cycle.
http://www.und.edu/instruct/eng/fkarner/pages/cycle.htm

Emery, J. L. 1972. Shade Swamp Sanctuary. The Farmington River Watershed Association.

Hagstoem, N. T., Gerrish, W. B., Machowski, E. A. and Hyatt, W. A. 1989. A Survey of Connecticut Streams and Rivers- Farmington River, Park River and Stony Brook Drainages, F-66-R-1: Annual Performance Report. Connecticut Department of Environmental Protection. Hartford, CT.

Klein, R. D. 1979. Urbanization And Stream Quality Impairment. Water Resources Bulletin15(4): 948-963.

La Sala, Jr., A. M. 1964. Geology and Ground-Water Resources of the Bristol-Plainville-Southington Area, Connecticut. U.S. Government Printing Office, Washington.

Bevier, L. R. 1994. The Atlas of Breeding Birds of Connecticut. . Connecticut Department of Environmental Protection; State Geological and Natural History Survey of Connecticut.
Management Plan for the Mattabesset River Watershed. 2000. Middlesex County Soil and Water Conservation District.

National Climatic Data Center. 2003. Connecticut Climate Summary.
http://www.ncdc.noaa.gov/oa/climate/research/cag3/CT.html

National Geographic Society.1987. Field Guide to the Birds of North America. 2nd Edition. The National Geographic Society.

Rosen, D. & Gene Billings. 1996. Finding Birds in Connecticut. A Habitat-based Guide to 450 Sites. Connecticut.

Schueler, T. R. 1994. The Importance of Imperviousness. Watershed Protection Techniques 1(3): 100-111.

State of Connecticut. General Statutes of Connecticut.1997.Volume 2, Section 8-23.

The Pomperaug River Watershed Coalition, Inc. 2001. Pomperaug River State of the Watershed Report Preliminary Assessment.

Town of Farmington. 2003. Departments of Planning.

Town of Burlington. 2003. Departments of Public Works.

Town of Plainville. 2003. Departments of Public Works.

Town of Plymouth. 2003. Departments of Public Works.

Town of Plymouth. 2003. Water Pollution Control Facility.

U.S. Department of Commerce. U.S.Census Bureau. U.S. Census, 2000.

U.S. Department of the Interior. USGS, National Water Quality Assessment Fact Sheet 001-97, Trends in Nitrogen and Phosphorus Concentrations in Southern New England Streams, 1974-92.

U.S. EPA. 1996. Watershed Approach Framework. http://www.epa.gov/owow/watershed/framework

U.S. EPA. 2003. Superfund in New England. http://www.epa.gov/ne/superfund/

U.S. Geological Survey; Water Resources Division. East Hartford, CT. http://ct.water.usgs.gov/

United States Environmental Protection Agency. 2000. Office of Water, EPA 833-00-002, StormWater Phase II Final Rule.

United States Geological Survey. 1998. Water Quality in the Connecticut, Housatonic, and Thames River Basins, 1992-95.

United States Geological Survey. 2002. Peak Streamflow for Connecticut. http://nwis.waterdata.usgs.gov/ct/nwis/peak/?site_no=01189000&agency_cd=USGS

United States Geological Survey. 2003. Groundwater Well Data, Well BU2. http://nwis.waterdata.usgs.gov/ct/nwis/gwlevels.

University of Connecticut. The Map & Geographic Information Center (MAGIC). http://magic.lib.uconn.edu/

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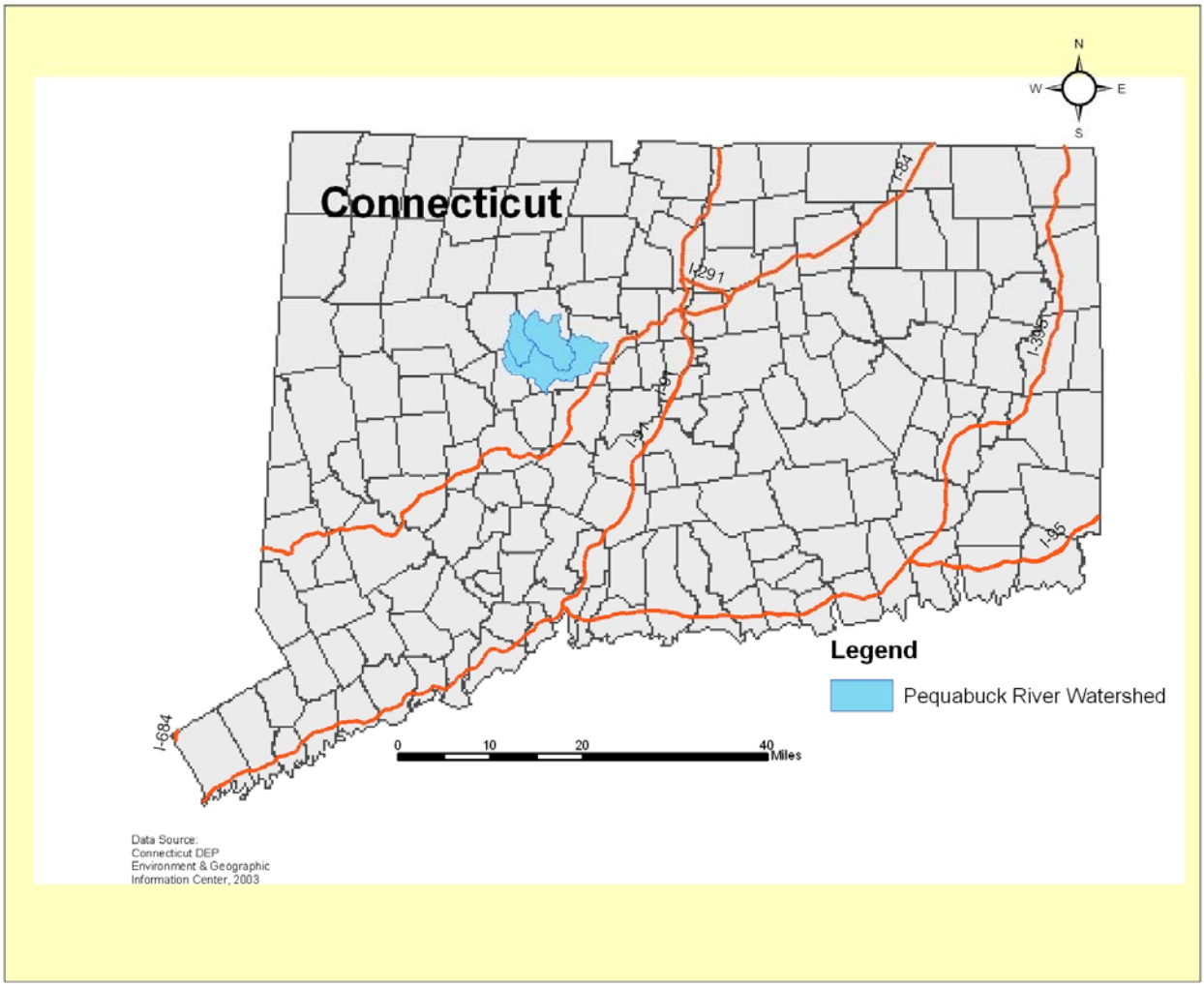

Editor: Pramod Pandey: CCRPA

Contributing Editors: Ken Shooshan-Stoller: CCRPA
Regina Mahony: FRWA
Eric Hammerling: FRWA
Mary Moulton: PRWA

Maps and Graphics: Pramod Pandey

Contacts

Central Connecticut Regional Planning Agency
225 N. Main St., Ste. 304
Bristol, CT 06010
(860) 589-7820
ccrpa@ccrpa.org
www.ccrpa.org

Farmington River Watershed Association
749 Hopmeadow St.
Simsbury, CT 06070
(860) 658-4442
info@frwa.org
www.frwa.org

Pequabuck River Watershed Association
P.O Box 1461
Bristol, CT 06010
prwa@comcast.net